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10ME/AU32A

Third Semester B.E. Degree Examination, June/July 2017
Material Science & Metallurgy

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Draw the unit cell of BCC and FCC and find the coordination number and atomic packing factor for both. **(08 Marks)**

b. With neat figures, explain the line defects in crystal imperfections. **(08 Marks)**

c. State and explain the Fick's first law of diffusion. **(04 Marks)**

2 a. Explain the meaning of resilience, modulus of resilience, ductility and toughness. **(08 Marks)**

b. Explain the mechanism of plastic deformation of single crystal by slip and twinning, with the help of neat sketches. **(08 Marks)**

c. Draw stress-strain diagrams showing ductile and brittle behavior of materials. **(04 Marks)**

3 a. Briefly explain the creep properties and stress relaxation. **(08 Marks)**

b. With neat sketches, explain the stages of fatigue failure. **(08 Marks)**

c. What is fracture? How are they classified? **(04 Marks)**

4 a. Explain briefly the process of homogeneous and heterogeneous nucleation. **(08 Marks)**

b. Explain the differences between substitutional and interstitial solid solutions. **(08 Marks)**

c. Write briefly about Gibb's phase rule and modified phase rule. **(04 Marks)**

PART – B

5 a. With neat sketches, explain the construction of phase diagram. **(08 Marks)**

b. Draw a neat sketch of F_e - $F_{e3}C$ equilibrium diagram. Label all the fields and on that demarcate the regions where the following reactions take place: (i) Eutectic (ii) Peritectic and (iii) Eutectoid. **(08 Marks)**

c. State and discuss lever rule with an example. **(04 Marks)**

6 a. Superimpose continuous cooling curves on TTT diagram and describe the various transformed products of austenite on cooling. **(08 Marks)**

b. With sketches, explain Austempering and Martempering. **(06 Marks)**

c. With a neat sketch, explain the process of induction hardening. **(06 Marks)**

7 a. Write the typical composition, important properties and general application of low carbon steel and high carbon steel. **(08 Marks)**

b. Write briefly about Brasses and Bronzes. **(06 Marks)**

c. Write composition, properties and uses of Al-Cu and Al-Si alloys. **(06 Marks)**

8 a. With a neat sketch, explain the production of MMC by sand casting technique. **(08 Marks)**

b. What is composite material? Write the classifications of composite materials. **(06 Marks)**

c. What are the advantages and applications of composites? **(06 Marks)**

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CBCS Scheme

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15ME32

Third Semester B.E. Degree Examination, June/July 2017
Material Science

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. With the help of Stress – strain diagrams, briefly explain the ductile and brittle behaviour of Engineering Materials. **(08 Marks)**

b. A 0.2% e steel component is to be carburized at 920^0C. Calculate the time required to increase the carbon content at 0.5mm below the surface to 0.4%.
$D920^0C = 1.28 \times 10^{-11}$ m^2/S. Carbon content is 0.9% at the surface. **(08 Marks)**

Z	0.75	0.80	0.85
erf Z	0.7112	0.7421	0.7707

OR

2 a. With a neat creep curve, explain different stages of creep deformation. **(08 Marks)**

b. Explain the mechanisms of fatigue failure in engineering materials with necessary diagram. **(08 Marks)**

Module-2

3 a. What is meant by Homogeneous nucleation? Derive an expression for critical radius required for homogeneous nucleation, with free energy curve. **(08 Marks)**

b. Explain Substitutional and Interstitial solid solutions. Discuss Hume – Rothary rules governing formation of solid solutions. **(08 Marks)**

OR

4 a. Draw a neat Iron – Carbon equilibrium phase diagram and label all phases, regions and invariant phase. **(08 Marks)**

b. Two metals A & B are completely soluble in liquid and partially soluble in solid state. Draw their phase diagram for following details.
i) Solid solubility of B in A is 5% at 600^0C and 0^0C.
ii) Solid solubility of A in B is 10% at 600^0C and 0^0C.
iii) Eutectic is formed at 60% B.
Also find the liquid and solid phase percentages in an alloy with 20% B at 650^0C. **(08 Marks)**

Module-3

5 a. Draw a neat labeled TTT diagram for eutectoid steel. Show a cooling curve for the formation of 100% marten site on it and explain the curve. **(08 Marks)**

b. Differentiate clearly between Normalizing and Annealing. Discuss Spheroidising Annealing with applications. **(08 Marks)**

OR

6 a. With a neat diagram, explain induction hardening process. Discuss the advantages, limitations and applications of the process. **(08 Marks)**

b. Discuss on various types of cast irons with necessary micro structures. **(08 Marks)**

Module-4

7 a. Differentiate between Thermo settling and Thermoplastic polymers. What are the advantages and disadvantages of plastic materials? **(08 Marks)**

b. What is meant by Residual Life Accessment? Explain the Nondestructive testing methods useful for Accessing residual life of materials. **(08 Marks)**

OR

8 a. Describe Shape memory alloys. Explain briefly the applications of shape memory alloys. **(08 Marks)**

b. Classify Ceramic materials. Explain the application and processing method of any one class. **(08 Marks)**

Module-5

9 a. Classify the composite materials on matrix and reinforcement. List the roles of matrix, reinforcement and interface. **(08 Marks)**

b. For a directionally oriented fiber – reinforced composite, the Young's modulus in iso - strain and iso – stress condition are 33.1 GPa and 3.66 GPa respectively. For a fiber volume fraction of 0.30, determine the Yong's modules for fiber and matrix phases. **(08 Marks)**

OR

10 a. With a neat figure, explain Injection moulding process for particulate reinforced polymers. **(08 Marks)**

b. List the advantages and limitations of composite materials. Mention any four applications of polymer matrix composites. **(08 Marks)**

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10ME/AU33

Third Semester B.E. Degree Examination, June/July 2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Use of thermodynamic data hand book is permitted.*

PART – A

1 a. What is meant by thermodynamic equilibrium? Explain mechanical, chemical and thermal equilibrium. **(08 Marks)**

b. Distinguish between:
(i) Macroscopic and microscopic approaches.
(ii) Point and path functions.
(iii) Cyclic and non cyclic process. **(06 Marks)**

c. The temperature on a thermometric scale is defined in terms of a property K by the relation $t = M\ln(K) + N$, where M and N are constants. The values of K are found to be 1.83 and 6.78 at Ice and steam points respectively. Determine the temperature corresponding to a value of K = 2.42 on the thermometer. **(06 Marks)**

2 a. Define work according to:
(i) Mechanics.
(ii) Thermodynamics. **(04 Marks)**

b. State the conditions to be satisfied for displacement work. Derive an expressions for displacement work in,
(i) Isothermal process.
(ii) Polytropic process. **(10 Marks)**

c. A spherical balloon has an initial diameter of 25 cm and contain air at 1.2 bar. Because of heating, the diameter of balloon increases to 30 cm and during the heating process, the pressure is found to be proportional to the diameter. Calculate the work done during the process. **(06 Marks)**

3 a. Prove that energy (E) is a property of a system. **(08 Marks)**

b. Derive steady flow energy equation with usual notations. **(06 Marks)**

c. A slow chemical reaction takes place in a fluid at constant pressure of 0.1 MPa. The fluid is surrounded by a perfect heat insulator during the reaction which begins at state 1 and ends at state 2. The insulation is removed and 150 KJ of heat flow to the surrounding as the fluid goes to state 3. The following data are observed for the fluid at states 1, 2 and 3.

State	Volume (m^3)	Temperature (°C)
1	0.003	20
2	0.3	70
3	0.06	20

Find the energy for this fluid system at states 2 and 3, if the energy at state 1 is zero. **(06 Marks)**

4 a. Show that COP of the heat pump is greater than COP of a refrigerator by unity. **(06 Marks)**

b. State and prove Carnot's theorem. **(06 Marks)**

c. An ice plant working on a reversed Carnot cycle; heat pump produces 15 tonnes of ice per day. The ice is formed from water at 0° C and formed ice is maintained at 0° C. The heat is rejected to the atmosphere at 25°C. The heat pump used to run the plant is coupled to Carnot engine which absorbs heat from the source which is maintained at 220°C by burning fuel of 44.5 MJ/kg calorific value and rejecting heat to atmosphere.
Determine (i) Power developed by the engine. (ii) Fuel consumed / hr.
Take enthalpy of fusion of ice = 334.5 KJ/kg. **(08 Marks)**

PART – B

5 a. With usual notations, explain Clausius theorem. **(08 Marks)**

b. Explain principle of increase of entropy. **(04 Marks)**

c. One kg of ice at -5°C is exposed to the atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe.
Take C_P of ice 2.093 KJ/kg K and
Latent heat of fusion of ice 333.3 KJ/kg. **(08 Marks)**

6 a. With the help of PV-diagram, explain the various regions of a pure substance. **(06 Marks)**

b. Sketch and explain combined separating and throttling calorimeter. **(06 Marks)**

c. Steam at 10 bar and 230°C is cooled under constant pressure until it becomes 0.85 dry. Using steam tables find the work done, change in enthalpy, heat transferred and change in entropy. **(08 Marks)**

7 a. Define Ideal gas. **(02 Marks)**

b. Show that the change in entropy for ideal gas is given by the expression:

$$(S_2 - S_1) = C_P \ln\left(T_2/T_1\right) - R \ln\left(P_2/P_1\right)$$ **(10 Marks)**

c. An ideal gas cycle consisting of three processes uses Argon (molecular weight = 40) as a working substance. Process 1 – 2 is reversible adiabatic process from 0.14 m^3, 700 KPa and 280°C to 0.056 m^3. The process 2 – 3 is a reversible isothermal process. Process 3 – 1 is an isobaric process. Sketch the cycle on P – V and T – S diagrams and find,
(i) Work transfer in process 1 – 2
(ii) Work transfer in process 2 – 3
(iii) Net work output from the cycle.
Assume $\gamma = 1.67$ **(08 Marks)**

8 a. Distinguish between ideal and real gases. **(04 Marks)**

b. Explain (i) Compressibility factor and
(ii) Compressibility chart. **(04 Marks)**

c. Define Dalton's law of partial pressure. **(04 Marks)**

d. Find the gas constant and apparent molar mass of a mixture of 2 kg O_2 and 3 kg N_2, given that universal gas constant is 8314.3 J/kgmoleK. Molar masses of O_2 and N_2 are respectively 32 and 28. **(08 Marks)**

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CBCS Scheme

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15ME33

Third Semester B.E. Degree Examination, June/July 2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer FIVE full questions, choosing one full question from each module.*
2. *Use of thermodynamic data hand book is permitted.*

Module-1

1 a. Distinguish between:
(i) Open system and isolated system
(ii) Intensive property and extensive property.
(iii) Cyclic process and non-cyclic process **(06 Marks)**

b. State zeroth law of thermodynamics and define equality of temperature. **(04 Marks)**

c. The temperature 't' on a linear Celcius scale is related to thermometric property 'X' by the relation, $t = A.\log_e X + B$, where A and B are constants. The value of X was found to be 1.47 and 5.2 at the ice point and steam point which are assigned the numbers 0 and 100 respectively on Celcius scale. Determine the temperature 't' corresponding to a reading of X equal to 2.65. **(06 Marks)**

OR

2 a. Define work from thermodynamic point of view. **(02 Marks)**

b. Derive an expression for the non-flow displacement work done during adiabatic process given by $PV^{\gamma} = C$, where $\gamma = \frac{C_p}{C_v}$. **(06 Marks)**

c. A closed system undergoes two processes one after the other – constant pressure process at a pressure of 5 bar from initial volume of 0.03 m^3 to 0.09 m^3. It is followed by polytropic expansion process according to $PV^{1.3} = C$ from 0.09 m^3 volume to 0.2 m^3 final volume. Sketch the two processes on PV diagram and find
(i) Final pressure after expansion.
(ii) Work done during each process and net work done. **(08 Marks)**

Module-2

3 a. State the I law of thermodynamics for a cyclic process. Obtain an expression for the I law of thermodynamics for a closed system undergoing change of state and prove that internal energy is a property. **(10 Marks)**

b. A steam turbine operating under steady flow conditions receives steam at a steady rate of 0.5 kg/s. Conditions of steam at turbine inlet are specific enthalpy h_1 = 2800 kJ/kg, velocity C_1 = 30 m/s, elevation Z_1 = 4 m. The conditions at the turbine outlet are specific enthalpy h_2 = 2380 kJ/kg, Velocity C_2 = 105 m/s and elevation z_2 = 1 m. Heat loss to the surroundings is 0.4 KJ/s. Using steady flow energy equation, determine power output of the turbine in kW. **(06 Marks)**

OR

4 a. State the limitations of I law of thermodynamics. **(02 Marks)**

b. State the Kelvin-Planck and Clausius statements of II law of thermodynamics. Show that Kelvin-Planck statement is equivalent to Clausius statement. **(08 Marks)**

c. A Carnot heat engine operates between source temperature of T_1K and sink temperature of T_2K. Difference between the source and sink temperature is 240. If the work developed by the Carnot engine is 0.74 times the heat rejected by the Carnot engine to the sink, find the efficiency of the Carnot engine and also source temperature and sink temperature. **(06 Marks)**

Module-3

5 a. Define reversible process and list any four factors that make a process irreversible. Explain any one factor. **(06 Marks)**

b. Prove that 'No heat engine is more efficient than a reversible heat engine, when both engines operate in cycle between same temperatures limits T_1 and T_2 with $T_1 > T_2$. **(06 Marks)**

c. Two reversible engines A and B working on Carnot cycle operate in series such that engine A receives heat from source maintained at 600 K and rejects heat to an intermediate sink maintained at T_I. Engine B receives heat rejected by engine A through intermediate sink and rejects heat to a sink maintained at 300 K. If both the engines have same efficiency, determine the temperature T_I of the intermediate sink. **(04 Marks)**

OR

6 a. State and prove Clausius inequality. **(06 Marks)**

b. Starting from I law show that for a reversible constant pressure process $(s_2 - s_1) = C_p \log_e\left(\frac{T_2}{T_1}\right)$. **(04 Marks)**

c. 1.5 kg of air is heated reversibly at constant pressure from 300 K to 600 K and is then cooled reversibly at constant volume back to initial temperature of 300 K. If initial pressure is 1 bar, calculate the entropy change during each process and net change in entropy. Sketch the processes on T-S diagram. Take C_P = 1.005 KJ/kgK and C_V = 0.718 KJ/kgK. **(06 Marks)**

Module-4

7 a. Define the following: (i) Available energy (ii) Unavailable energy (iii) Effectiveness (iv) Irreversibility. **(08 Marks)**

b. A system at 800 K receives heat at the rate of 4000 KJ/min from a reservoir at 1200 K. The temperature of the surrounding (sink) is 300 K. Assuming that the temperature of the source and the system remain constant during heat transfer, obtain (i) the net change of entropy during heat transfer (ii) The decrease in available energy after heat transfer. **(08 Marks)**

OR

8 a. Define (i) Pure substance (ii) Dryness fraction. **(03 Marks)**

b. Explain with a neat sketch the working of a throttling calorimeter to determine the dryness fraction of wet steam. **(07 Marks)**

c. Superheated steam from an initial condition of 5 bar and 300°C is expanded isentropically to a pressure of 0.5 bar. Calculate : (i) Final condition of steam after expansion. (ii) Change in enthalpy / kg of steam (iii) Change in internal energy / kg of steam. **(06 Marks)**

Module-5

9 a. Define as applied to ideal gas mixtures: (i) Mole fraction (ii) Dalton's law of partial pressures. (iii) Relative humidity.(iv) Due point temperature. **(08 Marks)**

b. A mixture of ideal gases contain 5 kg of N_2 and 8 kg of CO_2. The partial pressure of N_2 in the mixture is 120 KPa. Find (i) Mole fraction of N_2 and CO_2 (ii) Partial pressure of CO_2. (iii) Molecular weight of the mixture. **(08 Marks)**

OR

10 a. Write a brief note on: (i) Reduced properties. (ii) Law of corresponding states. **(04 Marks)**

b. Derive an expression for the Vander Waal's constants 'a' and 'b' in terms of critical properties. **(06 Marks)**

c. 1 kg of CO_2 has a volume of 0.86 m^3 at 120°C. Compute the pressure using
(i) Ideal gas equation.
(ii) Vander Waal's equation.
Take Vander Waal's constants for CO_2

$a = 365.6 \frac{KNm^4}{(kgmole)^2}$ and $b = 0.0423 \frac{m^3}{kgmole}$ **(06 Marks)**

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CBCS Scheme

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15ME/MA34

Third Semester B.E. Degree Examination, June/July 2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Define the following: (i) Elasticity (ii) Ductility (iii) Toughness (iv) Hardness (v) Stiffness (vi) Resilience **(06 Marks)**

b. The tensile test was conducted on a mild steel bar. The following data was obtained from the test. Diameter of the steel bar = 16 mm; Gauge length of the bar = 80 mm; Load at proportionality limit = 72 kN; Extension at a load of 60 kN = 0.115 mm; Load at failure = 80 kN; Final Gauge length of bar = 104 mm; Diameter of the rod at failure = 12 mm. Determine : (i) Young's modulus (ii) Proportionality limit. (iii) True breaking stress (iv) Percentage elongation. **(10 Marks)**

OR

2 a. Derive a relation between modulus of elasticity and bulk modulus. **(06 Marks)**

b. At room temperature, the gap between bar A and bar B shown in Fig. Q2 (b) is 0.25 mm. What are the stresses induced in the bars, if the temperature rise is 35°C. Given, $A_A = 1000\ mm^2$; $A_B = 800\ mm^2$; $E_A = 2\times10^5$ N/mm^2; $E_B = 1\times10^5$ N/mm^2; $\alpha_A = 12\times10^{-6}/^\circ C$; $\alpha_B = 23\times10^{-6}/^\circ C$; $L_A = 400\ mm$; $L_B = 300 mm$ **(10 Marks)**

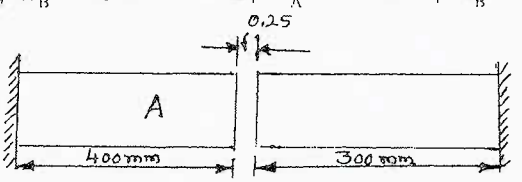

Fig. Q2 (b)

Module-2

3 a. A point in a strained material is subjected to a tensile stress of 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliguity on a plane making an angle of 30° with the axis of second stress. Also find the maximum shear stress. **(10 Marks)**

b. A thick cylindrical shell of 160 mm internal diameter is subjected to an internal pressure of 8 N/mm^2. Find the thickness of shell if the permissible or hoop stress in the section is not to exceed 35 N/mm^2. **(06 Marks)**

OR

4 a. An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence determine the magnitudes and directions of principal stresses and also the greatest shear stress. **(08 Marks)**

b. A thin cylindrical shell with following dimensions is filled with a liquid at atmospheric pressure : Length = 1.2 m, External diameter = 200 mm, Thickness of metal = 8 mm. Find the value of the pressure exerted by the liquid on the walls of the cylinder and the hoop stress induced if an additional volume of 25000 mm^3 of liquid is pumped into the cylinder. Take $E = 2.1\times10^5$ N/mm^2 and $\mu = 0.33$. **(08 Marks)**

Module-3

5 For the beam shown in Fig. Q5. Draw shear force and bending moment diagram. Locate the point of contraflexure if any. **(16 Marks)**

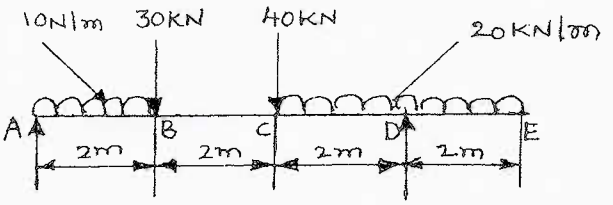

Fig. Q5

OR

6 a. Derive a relationship between bending stress and radius of curvature. **(08 Marks)**

b. Derive the deflection equation, $EI\frac{d^2y}{dx^2} = M$. **(08 Marks)**

Module-4

7 a. State the assumptions made in pure torsion theory. **(04 Marks)**

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm, Find the diameter of the shaft, if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 time of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(12 Marks)**

OR

8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. **(08 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2\times10^5$ N/mm^2. **(08 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stresses. **(08 Marks)**

b. Write a note on: (i) Maximum principal stress theory. (ii) Maximum shear stress theory. **(08 Marks)**

OR

10 a. A hollow circular shaft 2 m long is required to transmit 1000 kW power, when running at a speed of 300 rpm. If the outer diameter of the shaft is 150 mm and inner diameter is 120 mm. Find the maximum shear stress and strain energy stored in the shaft. **(08 Marks)**

b. A solid circular shaft is subjected to a bending moment of 40 kN-m and a torque of 10 kN-m. Design the diameter of the shaft according to, (i) Maximum principal stress theory. (ii) Maximum shear stress theory.
Take $\mu = 0.25$, stress at elastic limit = 200 N/mm^2 and factor of safety= 2. **(08 Marks)**

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CBCS Scheme

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15ME/MA34

Third Semester B.E. Degree Examination, June/July 2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Define the following: (i) Elasticity (ii) Ductility (iii) Toughness (iv) Hardness (v) Stiffness (vi) Resilience **(06 Marks)**

b. The tensile test was conducted on a mild steel bar. The following data was obtained from the test. Diameter of the steel bar = 16 mm; Gauge length of the bar = 80 mm; Load at proportionality limit = 72 kN; Extension at a load of 60 kN = 0.115 mm; Load at failure = 80 kN; Final Gauge length of bar = 104 mm; Diameter of the rod at failure = 12 mm. Determine : (i) Young's modulus (ii) Proportionality limit. (iii) True breaking stress (iv) Percentage elongation. **(10 Marks)**

OR

2 a. Derive a relation between modulus of elasticity and bulk modulus. **(06 Marks)**

b. At room temperature, the gap between bar A and bar B shown in Fig. Q2 (b) is 0.25 mm. What are the stresses induced in the bars, if the temperature rise is 35°C. Given, $A_A = 1000\,mm^2$; $A_B = 800\,mm^2$; $E_A = 2\times10^5$ N/mm^2; $E_B = 1\times10^5$ N/mm^2; $\alpha_A = 12\times10^{-6}/^\circ C$; $\alpha_B = 23\times10^{-6}/^\circ C$; $L_A = 400\,mm$; $L_B = 300mm$ **(10 Marks)**

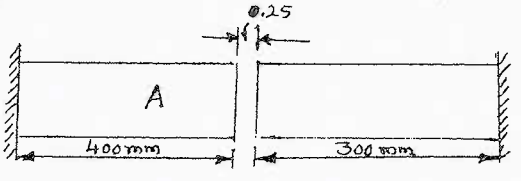

Fig. Q2 (b)

Module-2

3 a. A point in a strained material is subjected to a tensile stress of 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliguity on a plane making an angle of 30° with the axis of second stress. Also find the maximum shear stress. **(10 Marks)**

b. A thick cylindrical shell of 160 mm internal diameter is subjected to an internal pressure of 8 N/mm^2. Find the thickness of shell if the permissible or hoop stress in the section is not to exceed 35 N/mm^2. **(06 Marks)**

OR

4 a. An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence determine the magnitudes and directions of principal stresses and also the greatest shear stress. **(08 Marks)**

b. A thin cylindrical shell with following dimensions is filled with a liquid at atmospheric pressure : Length = 1.2 m, External diameter = 200 mm, Thickness of metal = 8 mm. Find the value of the pressure exerted by the liquid on the walls of the cylinder and the hoop stress induced if an additional volume of 25000 mm^3 of liquid is pumped into the cylinder. Take $E = 2.1\times10^5$ N/mm^2 and $\mu = 0.33$. **(08 Marks)**

Module-3

5 For the beam shown in Fig. Q5. Draw shear force and bending moment diagram. Locate the point of contraflexure if any. **(16 Marks)**

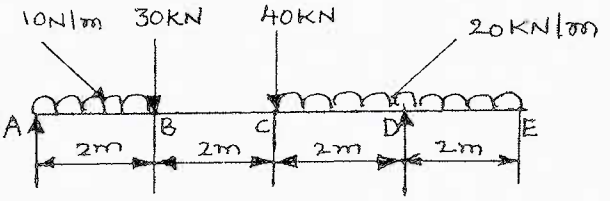

Fig. Q5

OR

6 a. Derive a relationship between bending stress and radius of curvature. **(08 Marks)**

b. Derive the deflection equation, $EI\frac{d^2y}{dx^2} = M$. **(08 Marks)**

Module-4

7 a. State the assumptions made in pure torsion theory. **(04 Marks)**

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm, Find the diameter of the shaft, if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 time of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(12 Marks)**

OR

8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. **(08 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2\times10^5$ N/mm^2. **(08 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stresses. **(08 Marks)**

b. Write a note on: (i) Maximum principal stress theory. (ii) Maximum shear stress theory. **(08 Marks)**

OR

10 a. A hollow circular shaft 2 m long is required to transmit 1000 kW power, when running at a speed of 300 rpm. If the outer diameter of the shaft is 150 mm and inner diameter is 120 mm. Find the maximum shear stress and strain energy stored in the shaft. **(08 Marks)**

b. A solid circular shaft is subjected to a bending moment of 40 kN-m and a torque of 10 kN-m. Design the diameter of the shaft according to, (i) Maximum principal stress theory. (ii) Maximum shear stress theory.
Take $\mu = 0.25$, stress at elastic limit = 200 N/mm^2 and factor of safety= 2. **(08 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, June/July 2017

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. List and explain the mechanical properties of engineering materials. **(10 Marks)**

b. A round stepped bar is subjected to an axial force of 30 kN. Diameter and length of first portion are 40 mm and 200 mm respectively and those of second portion are 20 mm and 100 mm respectively. Determine change in deformation when a uniform bar with same volume and length as that of stepped bar is subjected to 30 kN. Take E = 200 GPa. **(10 Marks)**

2 a. Show the relation between Young's modulus and modulus of rigidity. **(10 Marks)**

b. A compound bar consisting of steel, Bronze and aluminium bars connected in series is held between two supports as shown in Fig.Q2(b). When the temperature of the compound bar is increased by 50°C, determine the stresses induced in each bar. Consider the two cases: i) Rigid supports and ii) Supports yield by 0.5 mm. Take $\alpha_s = 12\times10^{-6}/°C$, $\alpha_B = 19\times10^{-6}/°C$, $\alpha_{AL} = 22\times10^{-6}/°C$, $E_s = 200$ GPa, $E_B = 83$ GPa and $E_{AL} = 70$ GPa.

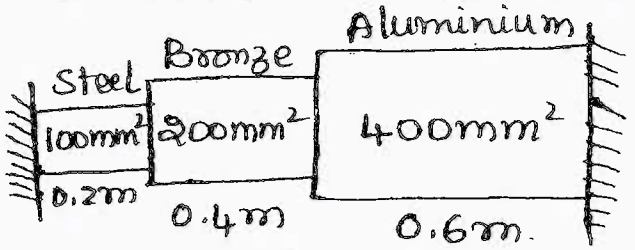

Fig.Q2(b) **(10 Marks)**

3 a. Explain : i) Principal planes and principal stresses and ii) Maximum and minimum shear stresses with respect to compound stress. **(06 Marks)**

b. Describe the construction of Mohr's circle for plane stress. **(06 Marks)**

c. A point in a beam is subjected to maximum tensile stress 110 MPa and shear stress 30 MPa. Find the magnitudes and directions of principal stresses. If the point in the beam is in the compression zone under the same magnitude of bending stress and shear stress. Find the magnitudes of principal stresses and their directions. **(08 Marks)**

4 a. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinders. **(10 Marks)**

b. A cylindrical pressure vessel of 1 meter inner diameter and 1.5 meters long is subjected to an internal pressure P, thickness of the cylinder wall is 15 mm. Taking allowable stress for cylinder material as 90 MPa. Determine: i) Magnitude of maximum internal pressure P that the pressure vessel can with stand and ii) Change in dimensions. Take E = 200 GPa and $\gamma = 0.3$. **(10 Marks)**

PART – B

5 a. Define and explain the following terms:
i) Shear force ii) Bending moment
iii) Shear force iv) Bending moment diagram **(06 Marks)**

b. Define and explain the following types of load:
i) Concentrated load
ii) Uniformly distributed load
iii) Uniformly varying load **(06 Marks)**

c. A simply supported beam of length 6m, carries point load of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam. **(08 Marks)**

6 a. What do you mean by 'simple bending'? What are the assumptions made in the theory of simple bending? **(07 Marks)**

b. A cantilever of length 2 meter fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm × 60 mm, find the stress at the failure. **(05 Marks)**

c. An I-section beam 350 mm × 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 kN, find the maximum shear stress developed in the I-section. **(08 Marks)**

7 a. Derive an equation for deflection. **(10 Marks)**

b. What is a Macaulay's methods? Where is it used? **(04 Marks)**

c. A 2 meters long cantilever is subjected to UDL of 10 kN/m throughout its length and is vertically downward point load 20 kN at its free end. Taking E = 200 GPa and maximum deflection as 0.3 mm determine the width and depth of rectangular section. Depth of the section is twice the width. **(06 Marks)**

8 a. Derive the relation for a circular shaft when subjected to torsion as given by $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$.
Also list out the assumptions made while deriving the relation. **(10 Marks)**

b. Derive an expression for the Euler's crippling load for a long column when both the ends of the column are hinged. **(10 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, June/July 2017
Manufacturing Process – I

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the casting process. Explain the different steps involved in casting process. **(08 Marks)**

b. What is pattern? Explain briefly any two types of pattern allowances. **(06 Marks)**

c. Write a Note on Binders and Additives used in moulding. **(06 Marks)**

2 a. With a neat figure, explain the Terminologies of sand mould. **(08 Marks)**

b. What are the desirable properties of moulding sand? **(06 Marks)**

c. Mention the various casting defects. Explain any two types of defects. **(06 Marks)**

3 a. With a neat sketch, explain the investment moulding process. Mention its advantages. **(10 Marks)**

b. Define the "Die casting". With a neat sketch, Explain the Hot chamber die casting process. **(10 Marks)**

4 a. With a neat sketch, explain the working principle of electric Resistance Furnace. **(10 Marks)**

b. Explain the construction and working principle of a cupola Furnace, with a sketch. **(10 Marks)**

PART – B

5 a. Define welding process. What are the advantages and limitations of welding process? List the industrial applications of welding. **(10 Marks)**

b. With a neat sketch, explain the Tungsten Inert gas welding (TIG) with advantages. **(10 Marks)**

6 a. With a neat sketch, explain the Resistance Butt welding process with its applications. **(10 Marks)**

b. With a sketch, explain the electron beam welding. Mention its applications. **(10 Marks)**

7 Write short notes on :

a. Different zones in welding

b. Parameter affecting HAZ

c. Effects of Residual stresses

d. Welding defects. **(20 Marks)**

8 a. Compare the soldering and Brazing processes. **(05 Marks)**

b. What is NDT? With neat sketches, explain the magnetic particle and ultrasonic testing techniques. **(15 Marks)**

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CBCS Scheme

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15ME35B

Third Semester B.E. Degree Examination, June/July 2017
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Explain with a neat sketch, the main parts of a lathe machine. **(08 Marks)**

b. Sketch and explain radial drilling machine and list the classification of drilling machine. **(08 Marks)**

OR

2 a. Draw a neat sketch to show major parts of a horizontal milling machine. **(08 Marks)**

b. Sketch a planning machine indicating major parts. Name any one of the mechanism for quick return movement in a planer. **(08 Marks)**

Module-2

3 a. What are the different motion provided on a lathe? **(06 Marks)**

b. List and explain different machining parameters and related quantities on a lathe. **(05 Marks)**

c. What are the tools used on lathes? **(05 Marks)**

OR

4 a. Explain the process of up-milling and down milling. What are advantages of each process? **(06 Marks)**

b. List and explain different machining parameters and related quantities on a broaching machine. **(05 Marks)**

c. Draw a neat sketch and explain centerless grinding machine. **(05 Marks)**

Module-3

5 a. Explain the geometry of a single point cutting tool with a neat sketch. **(06 Marks)**

b. List and explain the essential properties of cutting tool materials. **(05 Marks)**

c. Explain the effect of machining parameters on surface finish. **(05 Marks)**

OR

6 a. A workpiece of diameter 38 mm and length 400 mm was turned on a lathe using suitable cutting tool. Determine the machining time to reduce the workpiece to 36.5 mm diameter in one pass with cutting speed of 30 mpm and feed 0.7 mm/rev. **(08 Marks)**

b. A shaping machine is used to machine a rectangular piece of 18 cm long and 35 cm width which cutting speed being 26 m/min. Feed is 0.8 mm/cycle cutting stroke is adjusted to 20 cm. Time for cutting to return stroke is 3 : 2. Find the time required for machining the whole surface. **(08 Marks)**

Module-4

7 a. Briefly explain the different types of chips produced during metal cutting with neat sketches. **(06 Marks)**

b. Draw merchants circle diagram using usual notations and state the assumptions. **(05 Marks)**

c. The following data refer to an orthogonal cutting process. Chip thickness 0.62 mm, feed 0.2 mm, rake angle 15°. Calculate chip reduction co-efficient and shear angle. **(05 Marks)**

OR

8 a. What are the components of cutting force in turning a cylindrical job? **(06 Marks)**

b. Derive an expression for power needed in a turning operation. **(05 Marks)**

c. List the drilling factors affect the drilling torque and thrust force. **(05 Marks)**

Module-5

9 a. Define tool life. List out the wear mechanisms. Explain any one. **(06 Marks)**

b. A tool life of 80 minute is obtained at a speed of 30 mpm and 8 minute at 60 mpm. Determine the tool life equation and cutting speed for 4 minute tool life. **(05 Marks)**

c. What is machinability? List out the machinability criteria. **(05 Marks)**

OR

10 a. What do you understand by economics of machining? How do you evaluate machining cost? **(08 Marks)**

b. Explain how do you evaluate the actual time of machining. **(08 Marks)**

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CBCS Scheme

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15ME35A

Third Semester B.E. Degree Examination, June/July 2017
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Explain briefly with an example the term Manufacturing. **(04 Marks)**

b. State the factors which determine the selection of a casting alloy and the casting process to be employed. **(04 Marks)**

c. Define Pattern. List the types and briefly explain Pattern Allowances. **(08 Marks)**

OR

2 a. Enumerate the desirable properties of molding sand. **(08 Marks)**

b. Explain with sketch, shell moulding process. **(04 Marks)**

c. Show the Graphical representation of Gating system labeling all its components. **(04 Marks)**

Module-2

3 a. Classify Melting furnaces. Explain any one of them with neat sketch. **(08 Marks)**

b. Explain the working of Cupola and mark different heat zones clearly. **(08 Marks)**

OR

4 a. Differentiate between true centrifugal casting and centrifuge casting with sketches. **(08 Marks)**

b. Describe with a neat sketch, Thixo casting process and mention its advantages, limitations and applications. **(08 Marks)**

Module-3

5 a. Why is Directional Solidification essential in casting? Explain the methods available to achieve the same with sketches. **(10 Marks)**

b. State the advantages and limitations of casting process. **(06 Marks)**

OR

6 a. List the casting defects. List the causes and recommend remedial measures to overcome them. **(08 Marks)**

b. Explain the melting of Aluminium using stir casting setup. **(08 Marks)**

Module-4

7 a. Define Welding and classify them on the basis of Energy resources. **(04 Marks)**

b. Differentiate between MIG and TIG welding. **(06 Marks)**

c. With a neat sketch, explain the working of Atomic Hydrogen Welding (AHW) process. **(06 Marks)**

OR

8 a. With a neat sketch, explain the principle , process of LASER welding and mention its advantages. **(08 Marks)**

b. Explain the following processes with neat sketches :

i) Friction welding ii) Explosive welding. **(08 Marks)**

Module-5

9	a.	What is Heat Affected Zone (HAZ)? Enumerate the parameters affecting it.	(06 Marks)
	b.	What are Welding defects? Explain any five with sketches.	(08 Marks)
	c.	What are the functions of Electrode coatings?	(02 Marks)

OR

10	a.	Differentiate between Soldering and Brazing process.	(06 Marks)
	b.	What is NDT? Give broad classification of NDT.	(04 Marks)
	c.	Explain the following test with respect to welding with neat sketches : i) Holographic Inspection ii) Magnetic Particle Inspection.	(06 Marks)

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CBCS Scheme

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15ME36B

Third Semester B.E. Degree Examination, June/July 2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Brief the need of Inspection. **(04 Marks)**
b. What are the principles of measurements? **(04 Marks)**
c. Explain the process of measurement. **(04 Marks)**
d. What are the causes of Errors in measurements? **(04 Marks)**

OR

2 a. Explain the wavelength standard of measurements. **(04 Marks)**
b. What care should be taken in use of slip gauges? **(04 Marks)**
c. What is Sine bar? Explain the principle of sine bar. **(04 Marks)**
d. With a sketch, explain the principle of auto collimator. **(04 Marks)**

Module-2

3 a. Explain the types of fits. **(04 Marks)**
b. What is Hole basis and Shaft basis system? **(04 Marks)**
c. Define the Interchangeability and Selective Assembly. **(04 Marks)**
d. Explain the compound tolerance, with a suitable example. **(04 Marks)**

OR

4 a. What are the materials used in gauge manufacturing? **(04 Marks)**
b. List the functional requirements of a comparator. **(04 Marks)**
c. With a neat sketch, explain the optical comparator. **(08 Marks)**

Module-3

5 a. How do you measure the minor diameter of Internal threads? **(04 Marks)**
b. What is "Best Size wire"? Derive the best wire size in terms of pitch and flank angle. **(08 Marks)**
c. With a sketch, show the terminology of a spur gear. **(04 Marks)**

OR

6 a. With a neat sketch, explain the gear roll tester for composite error measurement. **(08 Marks)**
b. Explain the basic concept of coordinating measuring machine. **(08 Marks)**

Module-4

7 a. What is the significance of measurements? **(04 Marks)**
b. Explain in detail, the Generalized Measuring System. **(08 Marks)**
c. What is Transfer Efficiency? **(04 Marks)**

OR

8 a. What is Ballast Circuit? **(04 Marks)**
b. With a neat sketch, explain the Cathode Ray Oscilloscope. **(08 Marks)**
c. What are the advantages of Electrical intermediate modifying devices? **(04 Marks)**

Module-5

9 a. With a neat sketch, explain the Hydraulic dynamometer. **(08 Marks)**
b. Sketch and explain the working of an Pirani gauge. **(08 Marks)**

OR

10 a. List the strain gauge material and bonding material. **(04 Marks)**
b. Write a note on Mounting of Strain gauge. **(04 Marks)**
c. With a neat sketch, explain the Optical pyrometer. **(08 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, June/July 2017
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define coordination number. Also work-out the APF for FCC unit cell. **(08 Marks)**
b. Write note on crystal imperfections. **(04 Marks)**
c. Discuss diffusion process and laws of diffusion. **(08 Marks)**

2 a. Explain with stress-strain diagram the behavior of ductile metal under static tension till fracture. **(06 Marks)**
b. Discuss Johnson's offset method for finding yield stress. **(04 Marks)**
c. Distinguish between slip and twinning. **(04 Marks)**
d. A test bar of 6mm dia is subjected to tensile load of 600N and reduced to 5mm dia through plastic deformation. Calculate -- i) Engg. Stress ii) Engg. Strain iii) True stress iv) True strain. **(06 Marks)**

3 a. Define fracture. Illustrate stages of ductile metal fracture in tensile loading. **(07 Marks)**
b. Explain creep curve with stages of creep. **(06 Marks)**
c. Illustrate fatigue testing arrangement. Also draw S-N curve for ferrous and non-ferrous materials. **(07 Marks)**

4 a. Discuss homogeneous and heterogeneous nucleation. **(05 Marks)**
b. Sketch and explain crystal growth and cast metal structure. **(05 Marks)**
c. List and briefly explain "Hume-Rothazy rules'. **(05 Marks)**
d. State Gibbs phase rule and explain each term. **(05 Marks)**

PART – B

5 a. With neat figure explain lever rule. **(06 Marks)**
b. Draw Iron – Carbon equilibrium diagram and discuss the salient features. **(10 Marks)**
c. Briefly write about invariant reactions. **(04 Marks)**

6 a. Briefly explain TTT curves with figure. **(05 Marks)**
b. List and explain various heat treatment processes. **(10 Marks)**
c. Define hardenability and how it is determined. **(05 Marks)**

7 a. Compare the properties and composition of grey cast iron and malleable iron. **(08 Marks)**
b. Briefly discuss SG iron and steel properties. **(06 Marks)**
c. Classify the various brasses with their use. **(06 Marks)**

8 a. Define composite materials and list the classification. **(06 Marks)**
b. Discuss the fundamentals of production of FRP's and MMC's. **(08 Marks)**
c. List the advantages and application of composites. **(06 Marks)**

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CBCS Scheme

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15ME42

Fourth Semester B.E. Degree Examination, June/July 2017
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.
2. In the sketches of mechanisms, clearly distinguish link & construction line.

Module-1

1 a. Define 'kinematic pair' and 'degree of freedom'. Sketch 'spherical pair' and state its degree of freedom. **(06 Marks)**

b. Name an exact straight line motion mechanism having only turning pairs. Draw a neat proportionate sketch of the same. State geometric relationships among its links. Indicate the point tracing straight line and prove that the point can trace straight line. **(10 Marks)**

OR

2 a. In a 4-bar mechanism, the lengths of driver crank, coupler and follower link are 150 mm, 250 mm and 300 mm respectively. The fixed link length is L_0. Find the range of values for L_0 to make it a crank-rocker mechanism. **(06 Marks)**

b. Draw a neat proportionate sketch of 'Whitworth mechanism'. Indicate clearly the positions of driver crank corresponding to the extreme positions of shaper tool. **(06 Marks)**

c. State an application for the following:
i) Drag link mechanism ii) Oldham coupling
iii) Geneva wheel iv) Toggle mechanism **(04 Marks)**

Module-2

3 An IC engine mechanism has crank AB of 0.5m and connecting rod BC of 2m length. Crank AB rotates uniformly at 600 rpm in clockwise direction. When the crank has turned 45° from top dead centre (TDC), find the magnitude and direction of angular acceleration of connecting rod. **(16 Marks)**

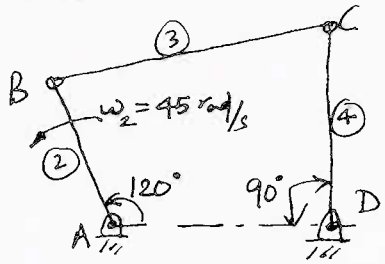
OR

4 a. State and prove Kennedy's theorem. **(06 Marks)**

b. A slider crank mechanism has crank of length 'r' and connecting rod 'l'. Crank rotates uniformly at 'ω' rad/s in anticlockwise direction. Crank has moved θ from IDC. Assuming r, l, ω and θ are known, state the procedure of 'Klein's construction' for:
i) Velocity analysis and ii) Acceleration analysis **(10 Marks)**

Module-3

5 A four bar mechanism ABCD is shown in Fig.Q5. Find the angular velocities of links 3 and 4 by complex algebra and vector algebra method, if ω_2 = 45 rad/s, counter clockwise, from first principles. **(16 Marks)**



AB = 100 mm
BC = r_3
CD = 300 mm
AD = 250 mm

Fig.Q5

OR

6 Obtain Freudenstein`s equation for four bar mechanism. **(16 Marks)**

Module-4

7 a. State law of gearing and define:
i) Path of contact and
ii) Arc of contact. **(06 Marks)**

b. The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6 mm. If the length of arc of contact is 1.75 times the circular pitch, find the addendum. **(10 Marks)**

OR

8 An epicyclic gear train has a fixed annular wheel C concentric with sun wheel A. A planet wheel B gears with A and C and can rotate freely on a pin carried by an arm D which rotates about an axis coaxial with that of A and C. If T_1 and T_2 are the numbers of teeth on A and C respectively, show that the ratio of the speeds of D to A is $\frac{T_1}{T_1 + T_2}$. **(16 Marks)**

Module-5

9 Draw the profile of a cam to raise a valve with SHM through 40 mm in $1/4^{th}$ revolution, keep it fully raised through $1/10^{th}$ revolution and to lower it with uniform acceleration and retardation in $1/6^{th}$ revolution. The valve remains closed during the rest of revolution. The diameter of roller is 20 mm and minimum radius of cam is 30 mm. The axis of valve rod passes through the axis of cam shaft. The cam rotates at 360 rpm, clockwise. Find maximum velocity and acceleration during raise and return of follower. **(16 Marks)**

OR

10 A symmetrical cam with convex flanks operates a flat-footed follower. The lift is 8 mm, base circle radius is 25 mm and the nose radius is 12 mm. If the total angle of cam action is 120°, find the radius of the convex flanks. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. **(16 Marks)**

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10ME/AU42B

Fourth Semester B.E. Degree Examination, June/July 2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define metrology. State the objectives of metrology. **(06 Marks)**

b. With the help of a neat sketch, explain "international prototype meter". **(06 Marks)**

c. Distinguish between line standard and end standard. **(04 Marks)**

d. Write a note on slip gauges and explain wringing phenomenon. **(04 Marks)**

2 a. Define the following geometrical tolerances:
i) Straightness ii) Circularity iii) Cilyndricity **(06 Marks)**

b. In brief, explain the concept of "Universal Interchangeability" and "selective assembly". **(06 Marks)**

c. Determine the dimensions to be provided for a shaft and hole of 90 mm size H8/e9 type fit. Size 90 mm falls in diameter step of 80 – 100 value of tolerance for IT8 and IT9 grades are 25i and 40i respectively. Value of fundamental deviation for 'e' type shaft is $-11\ D^{0.41}$. State the type of fit. **(08 Marks)**

3 a. Define a comparator and state the uses of comparator. **(04 Marks)**

b. With a neat sketch, explain the principle of sigma comparator. **(08 Marks)**

c. With the help of a neat sketch, explain the working principle of "zeiss ultra optimeter". **(08 Marks)**

4 a. With a neat sketch, explain the working principle of an 'autocollimator'. **(08 Marks)**

b. With the help of a sketch, define the following:
i) Major diameter ii) Minor diameter
iii) Effective or pitch diameter iv) Depth of thread **(06 Marks)**

c. Sketch and explain gear tooth verneir. **(06 Marks)**

PART – B

5 a. With the help of a block diagram, explain the "generalized measurement system". **(08 Marks)**

b. Define the following (with sketches wherever necessary):
i) Accuracy ii) Precision iii) Sensitivity iv) Repeatability **(08 Marks)**

c. What are the sources of errors in measurement? **(04 Marks)**

6 a. Explain the inherent problems present in the mechanical intermediate modifying devices. **(06 Marks)**

b. Explain the working principle of a 'cathode ray oscilloscope' (with sketch). **(08 Marks)**

c. What is a Ballast circuit? Explain with a neat sketch. **(06 Marks)**

7 a. With the help of a neat sketch, explain the working of a hydraulic dynamometer. **(08 Marks)**

b. Explain with a neat sketch the McLeod gauge used for pressure measurement. **(08 Marks)**

c. Sketch and explain the measurement of force using proving ring. **(04 Marks)**

8 a. Explain: i) Cross sensitivity and (ii) Temperature compensation. **(06 Marks)**

b. State the laws of thermocouple. **(04 Marks)**

c. Explain, how a strain gauge is calibrated. **(04 Marks)**

d. Explain the working of a resistance thermometer. **(06 Marks)**

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CBCS Scheme

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Fourth Semester B.E. Degree Examination, June/July 2017
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer FIVE full questions, choosing one full question from each module.*
2. *Use of thermodynamic data book is permitted.*

Module-1

1 a. Obtain air standard efficiency expression for diesel cycle. **(08 Marks)**

b. The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process the pressure is 1 bar and the temperature is 300 K. The heat transfer to the air per cycle is 1900 kJ/kg of air. Calculate:
i) Pressure and temperature at the end of each process of the cycle.
ii) Thermal efficiency. **(08 Marks)**

OR

2 a. With a neat sketch, explain the working of Ram jet. **(06 Marks)**

b. In a constant pressure open cycle gas turbine air enters at 1 bar and 20°C, leaves the compressor at 5 bar. Using the following data, temperature of gases entering the turbine = 680°C, pressure loss in the combustion chamber = 0.1 bar, compressor and turbine efficiency = 0.85 and 0.80, $\gamma = 1.4$, $C_p = 1.024$ kJ/kgK for air and gas, combustion chamber efficiency = 85%, find:
i) The quantity of air circulation if the plant develops 1065 kW.
ii) Heat supplied /kg of air circulation.
iii) The thermal efficiency of the cycle. Mass of the fuel may be neglected. **(10 Marks)**

Module-2

3 a. With a schematic diagram, explain the working of regenerative Rankine cycle. Show the process on T-S and H-S diagram. **(08 Marks)**

b. In a steam power plant operating on ideal Rankine cycle steam enters the turbine at 20 bar with an enthalpy of 3248 kJ/kg and an entropy of 7.127 kJ/kgK. The condenser pressure is 0.1 bar. Find the cycle efficiency and specific steam consumption in kg/kWh. Do not neglect pump work. **(08 Marks)**

OR

4 a. What are the advantages and disadvantages of binary vapour power cycle? **(06 Marks)**

b. In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550°C, If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5% and assuming ideal processes, determine: (i) Reheat pressure, (ii) Cycle efficiency, (iii) Steam rate, steal is reheated to 550°c. **(10 Marks)**

Module-3

5 a. Define the following:
i) Stochiometric air
ii) Enthalpy of formation
iii) Combustion efficiency. **(06 Marks)**

b. During a test on a diesel engine the following observations were made. The power developed by the engine is used for driving a DC generator. The output of the generator was, 210 A at 200 V, the efficiency of generator being 82%. The quantity of fuel supplied to the engine was 11.2 kg/h. Calorific value of fuel being 42600 kJ/kg. The air fuel ratio was 18:1. The exhaust gases were passed through an exhaust gas calorimeter for which the observations were as follows, water circulated through exhaust gas calorimeter = 580 lit/h, temperature rise of water through calorimeter = 36°C. Temperature of exhaust gases at exit from calorimeter = 98°C. Ambient temperature = 20°C. Heat lost to jacket cooling water = 32% total heat supplied. Specific heat of exhaust gases = 1.05 kJ/kgK. Calculate BP of the engine, η_{bt} and draw up heat balance sheet on minute basis. **(10 Marks)**

OR

6 a. With a P-θ diagram, explain the stages of combustion in CI engine. **(08 Marks)**

b. Benzene C_6H_6 is burnt in air and the analysis of the products of combustion yielded the following results:

$CO_2 = 10.96\%$, $CO = 0.5\%$, $O_2 = 7.5\%$, $N_2 = 81.04\%$.

Determine: i) Actual air-fuel ratio on mole basis ; ii) Actual air-fuel ratio on mass basis; iii) Percentage excess air. **(08 Marks)**

Module-4

7 a. With a schematic diagram, explain the working of vapour absorption refrigeration system. Show the processes on T-S diagram. **(08 Marks)**

b. An air conditioning plant is required to supply 60 m^3 of air/minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. **(08 Marks)**

OR

8 a. With a neat sketch explain the working of winter air conditioning system. Show the processes on psychrometric chart. **(08 Marks)**

b. An air refrigeration system working on Bell-Coleman cycle with 15 TOR capacity has its pressure range 1 bar to 10 bar. Air enters the compressor at −5°C and enters the expander at 25°C. Assuming isentropic expansion and compression, find COP, air flow rate and power required. **(08 Marks)**

Module-5

9 a. Show that for perfect intercooling, stage pressure ratio remains the same in multistage air compressor and hence prove that $Z = \left(\frac{p_{x+1}}{p_1}\right)^{1/x}$ where z = stage pressure ratio, p_1 = initial pressure, x = number of stages. **(09 Marks)**

b. Steam expands from 17 bar and 284°C to 0.7 bar in a convergent-divergent nozzle. Assuming that the expansion is frictionless and the steam discharged is 0.25 kg/s, calculate the diameter of the nozzle, (i) at a point where the pressure is 9.5 bar, (ii) at exit, using H-S chart. **(07 Marks)**

OR

10 a. Briefly explain the different types of flows in a steam nozzle. **(09 Marks)**

b. Determine the size of the cylinder of a double acting air compressor of 45kW in which air is taken at 1 atmosphere and compressed to 16 atmospheric pressure according to the law $PV^{1.25} = C$. Assume speed of the crank as 300 rpm, piston speed = 180 m/min. **(07 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2017
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of thermodynamic data hand book, charts and tables permitted.***

PART – A

1 a. Define the following:
(i) Combustion (ii) Stoichiometric air (iii) Enthalpy of combustion (iv) Enthalpy of formation (v) Adiabatic flame temperature. **(10 Marks)**

b. Butane is burned with air and volumetric analysis of the combustion products on dry basis yield following composition:

Gas	CO_2	CO	O_2	N_2
%	7.8	1.1	8.2	82.9

Determine percentage of theoretical air used. **(10 Marks)**

2 a. Derive the expression for the air standard efficiency of a Otto cycle with usual notation. State the assumptions made and represent the process on P-V and T-S diagram. **(10 Marks)**

b. An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar. Find the following:
(i) The air standard efficiency.
(ii) The mean effective pressure for the cycle.
Assume the ideal condition. **(10 Marks)**

3 a. Write elaborate note on heat balance sheet and Morse test on IC engine. **(10 Marks)**

b. A 4 cylinder petrol engine has an output of 52 KW at 2000 rpm. A Morse test is carried out and the brake torque readings are 177, 170, 168 and 174 N-m respectively. For normal running at this speed the specific fuel consumption is 0.364 kg/kWhr. The calorific value of fuel is 44200 kJ/kg. Calculate (i) Mechanical efficiency (ii) Brake thermal efficiency of the engine. **(10 Marks)**

4 a. Sketch the flow diagram and the corresponding temperature-entropy diagram of a reheat vapour cycle and derive an expression for the reheat cycle efficiency. State the advantages. **(10 Marks)**

b. A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550°C expands through the high pressure turbine. It is rehcated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-S and h-S diagram find (i) Quality of steam at exhaust (ii) Cycle efficiency (iii) Steam rate in kg/kWhr. **(10 Marks)**

PART – B

5 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. An air compressor takes in air at 1 bar and 20°C and compresses it according to law $PV^{1.2} = C$. It is then delivered to a receiver at a constant pressure of 10 bar R = 0.287 kJ/kg K. Determine

(i) Temperature at the end of compression.
(ii) Work done /kg of air.
(iii) Heat transferred during Compression/kg of air. **(10 Marks)**

6 a. Explain any two methods to improve the thermal efficiency of simple gas turbine with neat sketch and T-Q diagram. **(06 Marks)**

b. Write a note on turbojet propulsion. **(04 Marks)**

c. A gas turbine unit has a pressure ratio of 6 : 1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilo watts of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/sec. Take
C_P = 1.005 kJ/kgK and δ = 1.4 for compression process, C_P = 1.11 kJ/kgK and δ = 1.333 for the expansion process. **(10 Marks)**

7 a. Write a brief note on properties of refrigerants. **(04 Marks)**

b. With the neat sketch, explain working of vapour compression refrigeration system and draw T-S and H-S diagram for the same. **(06 Marks)**

c. A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 50°C and the lower temperature is -10°C. The capacity is to be 10 tonnes. Neglect all losses.
Determine : (i) C.O.P (ii) Heat rejected from the system per hr. (iii) Power required. **(10 Marks)**

8 a. Define the following: (i) Dry bulb temperature (ii) Wet bulb temperature
(iii) Specific humidity (iv) Relative humidity. **(06 Marks)**

b. With neat sketch, briefly describe summer air conditioning system. **(04 Marks)**

c. The atmospheric conditions are 20°C and specific humidity of 0.00095 kg/kg of air. Calculate the following:

(i) Partial pressure of vapour
(ii) Relative humidity
(iii) Dew point temperature. **(10 Marks)**

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CBCS Scheme

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15ME44

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define compressibility of a fluid. Derive an expression for compressibility of a fluid undergoing isentropic compression. **(04 Marks)**

b. A thin horizontal plate of area A is placed midway in a gap of height 'h' between two horizontal plane surfaces. The gap is filled with a liquid of viscosity μ_1. The plate requires a force F to move with a constant velocity V. The gap is now filled with another liquid of viscosity μ_2 and the same plate is placed at a distance of h/4 from one wall and parallel to it. Experiments indicate that for the same velocity V, the force required was same. Prove that $\mu_1 = \frac{4}{3}\mu_2$. **(07 Marks)**

c. A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipeline. Its left end is connected to the pipe and the right limb is open to the atmosphere. The centre of the pipe is 100 mm below the level of mercury in the right limb. If the difference of mercury level in the two limbs is 160 mm, determine the absolute pressure of oil in the pipe. Take atmospheric pressure = 100 kPa. **(05 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(08 Marks)**

b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of the cylinder and D is its diameter. **(08 Marks)**

Module-2

3 a. Derive the continuity equation in three dimensional Cartesian coordinates for a steady incompressible flow. **(06 Marks)**

b. Write the expressions for acceleration of a fluid in x, y and z directions. Differentiate between local and convective acceleration. **(05 Marks)**

c. The velocity potential function ϕ is given by an expression $\phi = -2\ln(x^2 + y^2)$. Show that it represents a possible case of fluid flow. **(05 Marks)**

OR

4 a. Derive an expression for discharge through a triangular notch. **(06 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2m and 0.6m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of the difference in the velocity head. Calculate the discharge. The flow is vertically upwards. The difference of elevation is 3.95 m. **(10 Marks)**

Module-3

5 a. Prove that the velocity distribution across a cross section of a circular pipe during viscous fluid flow is parabolic in nature. Also show that the maximum velocity is in the centre of the pipe and is equal to twice the average velocity. **(10 Marks)**

b. Water at 15°C flows between two parallel plates at a distance of 1.6 mm apart. Determine:
i) Maximum velocity
ii) Pressure loss per unit length
iii) Shear stress at the plate if the average velocity is 0.2 m/s. Viscosity of water at 15°C is 0.01 poise. Take unit width of the plate. **(06 Marks)**

OR

6 a. Derive Darcy-Weisbach equation for determining loss of head due to friction in a pipe. **(08 Marks)**

b. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head loss due to friction and power required to maintain the flow for a length of 1000 m. Take kinematic viscosity of oil = 0.29 stokes. **(08 Marks)**

Module-4

7 a. What is the meaning of boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(08 Marks)**

b. Using Rayleigh's method, show that the power P developed by a hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{N^2D^2}{gH}\right]$, where ρ = density of liquid, N = rotational speed of turbine in rpm, D = diameter of the runner, H = working head, g = gravitational acceleration. **(08 Marks)**

OR

8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid ρ, pump speed N in rpm, diameter of the impeller D, pressure P, viscosity of the fluid μ. Using Bucking Ham's π - theorem method, show that $Q = ND^3\phi\left[\frac{P}{\rho N^2D^2}, \frac{\mu}{\rho ND^2}\right]$. **(08 Marks)**

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal. The pull on the string is 24.525 N when the wind is flowing at a speed of 30 km/hr. find the corresponding coefficient of drag and lift. Take density of air = 1.25 kg/m^3. **(08 Marks)**

Module-5

9 a. Show that the velocity of a sound wave in a compressible fluid medium is given by $c = \sqrt{\frac{k}{\rho}}$ where k and ρ are bulk modules of elasticity and density of the fluid respectively. **(08 Marks)**

b. Calculate the velocity and mach number of a supersonic aircraft flying at an altitude of 1000 m where the temperature is 280 K. Sound of the aircraft is heard 2.15 seconds after the passage of the aircraft on the head of an observer. Take γ = 1.41 and R = 287 J/kgK. **(08 Marks)**

OR

10 a. Define stagnation temperature of a fluid. Show that the stagnation temperature and static temperatures are related by $\frac{T_0}{T} = 1 + \left(\frac{r-1}{2}\right)m^2$ where r = ratio of specific heats, m = mach number. **(08 Marks)**

b. Mention the applications and limitations of computational fluid dynamics. **(08 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, June/July 2017
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What is an inversion? Give the inversions of double slider crank chain. Explain any one with neat sketch. **(10 Marks)**

b. Distinguish between: i) Lower pair and higher pair ii) Completely constrained and successfully constrained motion. **(10 Marks)**

2 a. Sketch and explain Geneva wheel and Ackermann steering mechanism. **(10 Marks)**

b. Same different quick return mechanisms and explain any one with neat sketch. Why the names quick return mechanism? **(10 Marks)**

3 a. What are centripetal and tangential acceleration components? **(04 Marks)**

b. A four bar mechanism has a fixed link AD = 1m driving crank AB = 0.3m, follower link CD = 0.6m and the connecting link is 1.2m. The crank rotates at a speed of 300 rpm clockwise with an angular acceleration of 200 r/sec^2 in anticlockwise direction. When the angle made by the crank with a fixed link is 135° in anticlockwise direction, determine,

i) Angular velocity of the link BC and CD
ii) Angular acceleration of the link BC and CD
iii) Acceleration of B and C. **(16 Marks)**

4 a. State and prove Kennedy's theorem. **(05 Marks)**

b. The length of the crank and connecting rod of a reciprocating engine are 200mm and 800mm respectively. The crank is rotating at a uniform speed of 480 rpm. Using Klein's construction. Find :

i) acceleration of piston
ii) acceleration of the middle point of the connecting rod and
iii) angular acceleration of the connecting rod when the crank has turned through 45° from the inner dead center. **(15 Marks)**

PART – B

5 The slider crank of an internal combustion engine has a crank of 150mm length and a connecting rod of 600mm length. The crank rotates at a constant speed of 300rpm counter clockwise. Determine the position, velocity and acceleration of the slider when the crank angle is 45° from the inner dead center position by complex algebra. **(20 Marks)**

6 a. What is interference? Explain the methods of avoiding it. **(08 Marks)**

b. Two gear wheels mesh externally are to give a velocity ratio of 3. Involutes teeth arc of 6mm module and 20° pressure angle. The standard addendum is one module and the pinion rotates at 400 rpm. Find number of teeth on each wheel, so that the interference is just avoided, length of path of contact, maximum velocity of sliding between the teeth, arc of contact and contact ratio. **(12 Marks)**

7 a. Name different types of gear trains. Give a note on gear train used in lathe head stock. **(06 Marks)**

b. The Fig Q7 (b) shows an epicyclic gear train where the arm A is the driver and annular gear D is the follower. The wheel D has 112 teeth and B has 48 teeth, B runs freely on P and D is separately driven. The arm A runs at 100rpm and the wheel D at 50rpm in same direction, find the torque on B if A receives 7.5kW. **(14 Marks)**

8 A cam with 25mm as minimum radius is rotating clockwise at uniform speed of 100rpm and has to give the motion to a knife edge follower as mentioned below.

i) Follower to move outwards through 25mm during 120° of cam rotation.
ii) Follower to dwell for next 60° of cam rotation
iii) Follower to return to original position by next 90° of cam rotation
iv) Follower to dwell for rest of cam rotation.

The displacement of the follower takes place with uniform acceleration and retardation on both outward and return strokes. Draw the cam profile when follower axis passes through the axis of cam. Determine the maximum velocity and acceleration during outstroke and return stroke. **(20 Marks)**

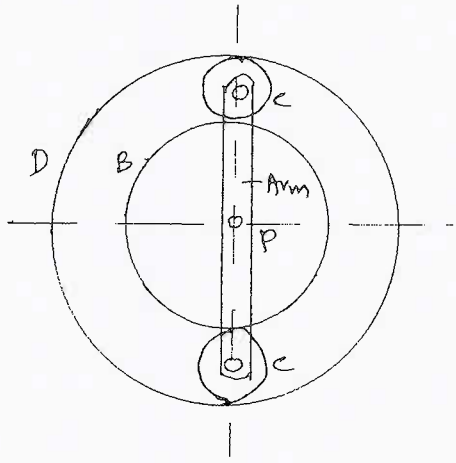

Fig Q8

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10ME/AU45

Fourth Semester B.E. Degree Examination, June/July 2017
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Give the nomenclature of single point cutting tool. **(05 Marks)**
b. Briefly explain the types of chips. **(08 Marks)**
c. What are the effects of cutting tool parameters on tool life **(07 Marks)**

2 a. Discuss the properties of following cutting tool materials:
(i) CBN (ii) Cemented carbides (iii) HSS **(10 Marks)**
b. Explain with a neat sketch how tool tip temperature is measured. **(10 Marks)**

3 a. Differentiate between capstan and turret lathe. **(06 Marks)**
b. Draw the tool layout to produce a hexagonal headed bolt on capstan lathe. **(07 Marks)**
c. With a neat sketch, explain the quick return mechanism of a shaper. **(07 Marks)**

4 a. Explain universal radial arm drilling machine with sketch. **(08 Marks)**
b. With a neat sketch explain the nomenclature of a drill bit. **(06 Marks)**
c. Briefly explain the principle of operation of CNC machines. **(06 Marks)**

PART – B

5 a. Differentiate between :
(i) Upmilling and down milling.
(ii) Face milling and end milling. **(10 Marks)**
b. What is indexing? List the different methods of indexing. Explain compound indexing. **(10 Marks)**

6 a. Briefly explain cylindrical centreless grinding process, with a neat sketch. Mention advantages of it over centre type grinding. **(08 Marks)**
b. Explain :
(i) GRIT (ii) GRADE (iii) Structure **(06 Marks)**
c. What are the factors considered while selecting grinding wheel? **(06 Marks)**

7 a. Sketch and explain Honing process and state its advantages. **(07 Marks)**
b. Explain the principle of broaching machine. **(07 Marks)**
c. Briefly explain :
(i) Super finishing process. (ii) Polishing (iii) Buffing operation. **(06 Marks)**

8 a. Differentiate between conventional and non-conventional machining process. **(06 Marks)**
b. Explain principle, equipment and operation of
(i) Laser Beam machining (LBM) (ii) Electron Discharge machining (EDM). **(14 Marks)**

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15ME45B/15MA45

Fourth Semester B.E. Degree Examination, June/July 2017
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define machine tool. Give classification of machine tool. **(06 Marks)**

b. With neat sketch, explain various parts of lathe machine. **(10 Marks)**

OR

2 a. Explain with neat sketch working principle of drilling machine. **(04 Marks)**

b. Sketch and label principle parts of shaper. **(06 Marks)**

c. Explain briefly constructional features of milling machine with neat sketch. (Column and knee type) **(06 Marks)**

Module-2

3 a. What is machining? Give classification of machining processes. **(06 Marks)**

b. With neat sketches, explain working and auxiliary motions in machine tools. **(10 Marks)**

OR

4 a. List the operations performed on a lathe and explain any four operations with neat sketches. **(08 Marks)**

b. Explain briefly with neat sketches of any five drilling machine operations. **(08 Marks)**

Module-3

5 a. Describe properties and characteristics of cutting tool materials. **(04 Marks)**

b. With neat sketch, explain principal angles of a single point cutting tool. **(06 Marks)**

c. Explain briefly Twist drill nomenclature with neat sketch. **(06 Marks)**

OR

6 a. Mention the basic requirements of cutting fluids. **(04 Marks)**

b. Discuss briefly about types of cutting fluids used in metal cutting process. **(06 Marks)**

c. List the parameters affecting the surface finish and explain them briefly. **(06 Marks)**

Module-4

7 a. A workpiece of 80 mm diameter and 120 mm length is held between centres and turned in 2 passes. If the approach length is 10 mm and over travel is 6 mm find machining time. Assume cutting speed as 0.4 m/sec and feed 0.4 mm/rev. **(08 Marks)**

b. Calculate the machining time required to reduce 60 mm diameter shaft to 50 mm diameter for a length of 1500 mm with depth of cut of 2 mm for rough cut and 1 mm for finish cut. The following details are given:

i) Cutting speed = 30 m/min
ii) Feed = 0.5 mm/rev
iii) Approach length = 5 mm
iv) Overrun length = 5 mm
v) Number of passes = 3 (2 rough cut + 1 finish cut) **(08 Marks)**

OR

8 a. A 63.5 mm diameter plain milling cutter having 6 teeth is used for face milling a block of aluminium 18 cm long and 3 cm wide. The spindle speed is 1500 rpm and the feed is 0.125 mm/tooth. Determine:
i) Table feed in mm/min
ii) Cutting time. **(08 Marks)**

b. Evaluate cutting speed and machining time for the plain (slab) milling operation for the following data:
Diameter of milling cutter = 100 mm
Cutting speed = 500 rpm
Depth of cut = 5 mm
Table feed = 100 mm/min
Length of workpiece = 50 cm
Number of teeth in the cutter = 8. **(08 Marks)**

Module-5

9 a. Explain briefly causes for the tool failure/wear with sketches. **(08 Marks)**

b. Discuss about tool wear mechanisms which are responsible for causing wear. **(08 Marks)**

OR

10 a. Mention the factors affecting tool life and explain them briefly. **(08 Marks)**

b. A tool life of 80 minute is obtained at a speed of 30 mpm (m per min) and 8 minute at 60 m per min. Determine the following:
i) Tool life equation
ii) Cutting speed for 4 minute tool life. **(08 Marks)**

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15ME45A

Fourth Semester B.E. Degree Examination, June/July 2017
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

1 a. List and briefly explain the steps involved in making sand casting. **(08 Marks)**

b. Explain in detail various allowance given to pattern and reasons to provide the allowance. **(08 Marks)**

OR

2 a. List the types of moulding sand. Briefly explain the properties of moulding sand. **(08 Marks)**

b. With a neat sketch, explain the working principle of Jolt and Squeeze machine. **(08 Marks)**

Module-2

3 a. With a neat sketch, explain the different zones present in CUPOLA FURNACE. **(08 Marks)**

b. How do you classify the melting furnace? Draw a neat sketch and explain the working of gas fired pit furnace. **(08 Marks)**

OR

4 a. What is die casting? Draw a neat sketch and explain the Hot chamber die casting process. **(08 Marks)**

b. With a neat sketch, explain centrifugal casting process. Mention merits and demerits. **(08 Marks)**

Module-3

5 a. What is nucleation? Explain types of nucleation with neat sketches. **(08 Marks)**

b. What is degasification in liquid metals? Mention the methods explain any one. **(08 Marks)**

OR

6 a. What is Fettling? Mention the steps involved in Fettling. Explain with sketch of any two casting defects. **(08 Marks)**

b. With a neat sketch, explain the principle of lift-out crucible furnace. **(08 Marks)**

Module-4

7 a. Sketch and explain TIG welding process. Mention its advantages and disadvantages. **(08 Marks)**

b. Explain with a neat sketch. atomic hydrogen welding. **(08 Marks)**

OR

8 a. With a neat sketch, explain LASER beam welding and mention its advantages. disadvantages and limitations. **(08 Marks)**

b. Sketch and explain seam welding. Mention advantages. disadvantages and applications. **(08 Marks)**

Module-5

9 a. What is heat affected zone (HAZ)? Explain the parameters affecting HAZ. **(08 Marks)**

b. Write short notes on: i) Welding defects, ii) Residual stresses. **(08 Marks)**

OR

10 a. With neat sketch, explain Oxy-acetylene welding process. **(08 Marks)**

b. What are different non-destructive testing (NDT) methods and explain with a neat sketch ultrasonic inspection method. **(08 Marks)**

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15ME46B

Fourth Semester B.E. Degree Examination, June/July 2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain with a sketch, the international prototype meter. **(08 Marks)**

b. Briefly explain: i) Wringing procedure ii) Principle of sine bar. **(08 Marks)**

OR

2 a. Explain the principle of Auto-collimeter with a neat sketch and list advantages of wavelength standards. **(08 Marks)**

b. Show the arrangement of minimum angle gauges required to obtain the following angles.
i) 32°36′24″ ii) 122°30′0″ **(08 Marks)**

Module-2

3 a. Define the terms : i) Limits ii) Fits iii) Tolerance. **(06 Marks)**

b. Illustrate the following types of gauges
i) Snap gauge ii) Ring gauge iii) Plain plug gauge. **(10 Marks)**

OR

4 a. Explain with a neat sketch, the working of SOLEX COMPARATOR. **(08 Marks)**

b. Differentiate measuring instruments, gauges and comparators. **(08 Marks)**

Module-3

5 a. With the setup, explain how effective diameter of a screw thread is measured using 3 wire method. **(08 Marks)**

b. Describe constant chord method to find tooth thickness. **(08 Marks)**

OR

6 a. List the advantages of Lasers and explain in detail any one laser interferometer. **(08 Marks)**

b. Sketch and explain a CMM. What are the various applications of CMM? **(08 Marks)**

Module-4

7 a. Briefly explain the following terms:
i) System response and time delay ii) Accuracy and error iii) Repeatability **(08 Marks)**

b. What is the necessity of modifying devices? Enlist the advantages of electrical modifying devices. **(08 Marks)**

OR

8 a. Explain with a neat sketch Ballast circuit. **(06 Marks)**

b. What are terminating devices? Explain in detail oscillograph. **(10 Marks)**

Module-5

9 a. Explain the working of Pirani gauge with a neat sketch. **(08 Marks)**

b. Explain with neat sketch Analytical Balance to measure unknown faces. **(08 Marks)**

OR

10 a. What is a thermocouple? Explain the Law's of thermocouple. **(08 Marks)**

b. Sketch and explain total Radiation pyrometers. **(08 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Differentiate between :
(i) Weight density and mass density.
(ii) Steady flow and unsteady flow.
(iii) Gas and Vapour **(06 Marks)**

b. A cube of 0.25 m sides and mass 28 kg slides down a plane inclined at 2 V: 3 H covered by a thin film of oil of viscosity 2.2×10^{-3} pa-sec. If the thickness of the film is 0.02 mm determine the steady state velocity of the block. **(06 Marks)**

c. A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of liquid if a torque of 20 N-m is required to rotate the inner cylinder at 120 rpm. **(08 Marks)**

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive an expression for centre of pressure on a vertically plane submerged body. **(06 Marks)**

c. The diameters of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when
(i) The pistons are at the same level.
(ii) Small piston is 40 cm above the large piston.
Take density of liquid in the jack as 1000 kg/m^3. **(08 Marks)**

3 a. Derive an expression for continuity equation in 3D-flow and deduce it to 2D flow. **(10 Marks)**

b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of cylinder and 'D' is its diameter. **(10 Marks)**

4 a. Obtain an expression for Euler's equation of motion along a stream line and deduce it to Bernouli's equation. **(08 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameters at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of mercury (vaccum), while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of difference in velocity head. Calculate the discharge. The flow is vertically upwards and difference of elevation is 3.9 m. **(12 Marks)**

PART – B

5 a. Using Buckingham's π theorem, for a screw propeller. The relation between thrust 'F', torque 'T', diameter 'D', speed of travel 'U' , speed of rotation 'N', Density 'ρ' and viscosity 'μ' may be put in the form $F = \rho D^2 U^2 \phi \left[\frac{\rho D^3 U^2}{T}, \frac{DN}{U}, \frac{\rho UD}{\mu}\right]$. **(10 Marks)**

b. A venturimeter with a throat diameter 10 cm and Area ratio '4' is provided in a vertical pipe line carrying oil of specific gravity 0.9. The difference in elevation of throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm, calculate

(i) Discharge of oil.

(ii) The pressure difference between entrance section and throat section. Take $C_d = 0.98$. **(10 Marks)**

6 a. Derive Darcy's equation for the loss of head due to friction in a circular pipe. **(10 Marks)**

b. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end for the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow, take f = 0.01 for both sections of pipe. **(10 Marks)**

7 a. Starting from first principles, show that for laminar flow between fixed parallel plates, the mean velocity is two-thirds of maximum velocity. **(10 Marks)**

b. The oil of specific gravity 0.82 is pumped through a horizontal pipe line 150 mm in diameter and 3 km long at the rate of 0.015 m^3/sec. The pump has an efficiency of 68% and requires 7.5 kW to pump the oil.

(i) What is dynamic viscosity of oil?

(ii) Is the flow is laminar? **(10 Marks)**

8 a. Explain the following:

(i) Stream line body (ii) Bluff body (iii) Mach number

(iv) Mach angle (v) Boundary layer thickness **(10 Marks)**

b. An aeroplane is flying at a height of 15 km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg-K, find the speed of the plane. **(04 Marks)**

c. Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The co-efficients of lift and drag are 0.75 and 0.15 respectively. Determine

(i) Drag force.

(ii) Lift force.

(iii) Resultant force. **(06 Marks)**

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CBCS Scheme

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15ME/MA32

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Material Science

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define APF. Calculate APF for HCP cell. **(06 Marks)**

b. With neat sketches explain surface defects briefly. **(05 Marks)**

c. Explain briefly the mechanical properties of a material in plastic range. **(05 Marks)**

OR

2 a. With neat sketches, explain cup and cone fracture. **(05 Marks)**

b. What is stress relation? Obtain an expression for stress relaxation. **(06 Marks)**

c. With S-N diagram explain fatigue behaviour of a material. **(05 Marks)**

Module-2

3 a. Explain different types of solid solution with sketches. **(04 Marks)**

b. State lever rule and Gibbs phase rule. Also explain Hume-Rothary rules for formation of solid solution. **(06 Marks)**

c. Two metals A and B have their melting points at 900°C and 800°C respectively. The alloy pair forms eutectic at 600°C at 60% B and 40% A. Both A and B have unlimited solubilities in liquid state. The solid state solubilities are 10% B in A at 600°C and 5% B in A at 0°C, and 8% A in B at 600°C and 4% A in B at 0°C. Assume solidus, liquidus and solvus lines are to be straight. No intermediate phase change occurs. Draw phase diagram and label at temperatures, phases and fields. Also find the room temp structure of an alloy of composition 60% A and 40% B, with respect to the number, type, extent and composition of the phases. **(06 Marks)**

OR

4 a. Draw Fe – Fe_3C diagram. Label all phases, temperatures. Explain solidification process for any one alloy. **(08 Marks)**

b. Define Homogeneous and Heterogeneous nucleation. Obtain an expression for critical radius of nucleation. **(08 Marks)**

Module-3

5 a. Draw TTT diagram for eutectoid steel and explain briefly. **(06 Marks)**

b. Distinguish between Austempering and martempering. **(05 Marks)**

c. Explain Flame hardening with neat sketch. **(05 Marks)**

OR

6 a. Explain composition, properties and uses of Gray cast Iron, white cast iron and S. G Iron. **(06 Marks)**

b. Explain solution hardening of Al – 4%C alloy. **(05 Marks)**

c. Write a note on Austenitic and Martensitic stainless steel. **(05 Marks)**

Module-4

7 a. What are ceramics? Briefly explain the types of ceramics. **(05 Marks)**

b. Write a note on mechanical properties of ceramics. **(05 Marks)**

c. Define smart material. Explain briefly the types of smart materials. **(06 Marks)**

OR

8 a. Give classification of polymers. List the characteristics of polymers. **(05 Marks)**

b. With a neat sketch explain the processing of plastic by injection moulding method. **(05 Marks)**

c. Write a note on piezo-electric material and shape memory alloys. **(06 Marks)**

Module-5

9 a. Define composite. Give its classification. **(05 Marks)**

b. With a neat sketch, explain filament winding process. List the applications of filament winding process. **(06 Marks)**

c. What is the role of matrix and reinforcement in composite materials? **(05 Marks)**

OR

10 a. Under Iso stress condition, obtain an expression for Young's modulus of a fibre reinforced composites. **(06 Marks)**

b. List the advantages and applications of composite material. **(05 Marks)**

c. Calculate the tensile modulus of elasticity of unidirectional carbon-fibre reinforced composite containing 62% of carbon fibres by volume in ISO-stress and ISO – strain condition. Take $E_{carbon\ fibre} = 37.86 \times 10^4$ N/mm^2, $E_{epoxy} = 41.98 \times 10^2$ N/mm^2. **(05 Marks)**

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10ME/AU32A

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Define Unit cell, Co-ordination number. (04 Marks)
b. Draw the FCC Lattice and calculate its atomic packing factor. (08 Marks)
c. Explain Crystal imperfections with figures. (08 Marks)

2 a. Define Engineering Stress and Strain and True stress and strain. Find out the relationship between True strain and Engineering strain. (08 Marks)
b. Define the following terms : i) Yield strength ii) Offset yield strength iii) Ductility iv) Ultimate strength v) Toughness. (08 Marks)
c. Compare Plastic deformation by slip and twinning. (04 Marks)

3 a. Explain types of fractures with figures. (08 Marks)
b. Draw the Creep curve and explain briefly. (06 Marks)
c. Explain types of fatigue loading with examples. (06 Marks)

4 a. Define Solid solutions and explain different types of solid solutions with figures. (08 Marks)
b. Explain the Mechanism of solidification. (05 Marks)
c. Explain the Construction of phase diagram with figure. (07 Marks)

PART – B

5 a. Draw the Fe – Fe_3C Equilibrium diagram and label the phases. (10 Marks)
b. Explain the construction of T.T.T diagram with figure and label it. (10 Marks)

6 a. Differentiate between Austempering and Martempering of steels. (06 Marks)
b. Write a brief note on annealing and normalizing heat treatments process. (06 Marks)
c. Explain Carburizing and flame hardening in brief. (08 Marks)

7 a. Mention the composition, properties and application of malleable iron. (08 Marks)
b. Briefly describe the properties and applications of α - Brasses and red brasses and mention their compositions. (06 Marks)
c. Write a brief note on aluminium and its alloys. (06 Marks)

8 a. With a neat sketch, explain the production of Fibre – reinforced plastics (any one method). (10 Marks)
b. Explain the advantages and applications of composite material. (10 Marks)

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10ME/AU32B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Describe with neat sketches : i) Imperial standard yard ii) International prototype meter. **(06 Marks)**

b. Distinguish between line and end standards. Give examples. **(04 Marks)**

c. Three 100mm gauges are measured on a comparator by wringing them together and then comparing with 300mm gauge. also intercomparing them. The 300mm gauge actually measures 300.0025mm. And three gauges together have a combination length of 300.0035mm. Gauge 'A' is 0.002mm longer than 'B' but shorter than 'C' by 0.001mm. Determine correct length of each gauge. **(10 Marks)**

2 a. Define the terms : i) Allowance ii) Tolerance iii) FIT iv) LIMITS. **(08 Marks)**

b. How do you classify plain gauges? Sketch and explain solid plug gauge and snap gauge. **(08 Marks)**

c. A 20mm diameter shaft and bearing are to be assembled with a clearance fit. The tolerance and allowances are as below : Allowance = 0.002mm ; Tolerance on hole = 0.005mm : Tolerance on shaft = 0.003mm. Find the limits of size of the hole and shaft with hole basis and shaft basis systems. The tolerances are disposed of unilaterally. **(04 Marks)**

3 a. What is a Comparator? List essential characteristics of a good comparator. **(06 Marks)**

b. Briefly describe construction and working of a SOLEX pneumatic comparator. **(08 Marks)**

c. Explain how a sine bar is used to measure the angle of a component of large size. **(06 Marks)**

4 a. Write a short note on Optical flats. **(04 Marks)**

b. Illustrate the following methods :
   i) Measurement of minor diameter using two V – pieces.
   ii) Measurement of effective diameter using thread micrometer. **(08 Marks)**

c. Describe with neat sketch, the working principle and applications of Tool Makers Microscope. **(08 Marks)**

PART – B

5 a. Explain the following terms : i) Accuracy and precision ii) Repeatability iii) Error iv) Systematic error's. **(08 Marks)**

b. Sketch and explain generalized measuring system taking pressure gauges as an example. **(08 Marks)**

c. List the advantages and disadvantages of capacitive transducers. **(04 Marks)**

6 a. Briefly explain the following : i) Chopper Amplifier ii) Carrier Amplifier. **(06 Marks)**

b. With a neat diagram, explain the following :
   i) Light Beam type oscillograph ii) X – Y Plotter. **(14 Marks)**

7 a. Define Force. What are the basic methods of measurement of force? **(06 Marks)**

b. With a neat diagram, explain the working of a mechanical dynamometer and list its limitations. **(08 Marks)**

c. Briefly discuss principle of Pirani gauge. **(06 Marks)**

8 a. What is a Thermocouple? Explain the principle on which it works and list its advantages and limitations. **(08 Marks)**

b. Write a brief note on Optical pyrometer with its advantages and disadvantages. **(08 Marks)**

c. What are Electrical Strain gauges? Discuss. **(04 Marks)**

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10ME33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Use of steam table permitted.

PART – A

1 a. Distinguish between:
i) Intensive and extensive properties.
ii) Microscopic and macroscopic point of view.
iii) Adiabatic boundary and a diathermic boundary. **(06 Marks)**

b. With neat diagram, explain the working of constant volume gas thermometer for measurement of temperature. **(08 Marks)**

c. State Zeroth law of thermodynamics. The temperature T on a thermometric scale is defined as T = a/n k + b where a and b are constant. The values of K are found to be 1.83 and 6.78 at 0°C and 100°C respectively calculate the temperature for a value of K = 2.42. **(06 Marks)**

2 a. With a neat P-V diagram, derive an expression for work done during polytropic process ($PV^n = C$). **(05 Marks)**

b. Explain p-dv work and prove that work in a path function. **(06 Marks)**

c. A fluid contained in a horizontal cylinder with a frictionless lead proof piston is continuously agitation by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.4m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485m against the atmospheric pressure of 101kpa. The network done by fluid during the process is 2kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine the torque in the shaft. **(09 Marks)**

3 a. Write the steady flow energy equation and modify the SFEE for the following cases:
i) Adiabatic expansion of steam in turbine.
ii) Horizontal steam nozzle with negligible entrance velocity. **(06 Marks)**

b. A slow chemical reaction takes place in a fluid at a constant pressure of 0.1 MPa. The fluid is surrounded by a perfect heat insulator during the reaction which begins at state 1 and ends at state 2. The insulation is then removed and 105 kJ of heat flow to the surroundings as the fluid goes to state 3. The following data are observed for the fluid at state 1, 2 and 3.

State	Volume (m^3)	t°C
1	0.03	20
2	0.3	370
3	0.06	20

For the fluid system calculate E_2 and E_3 if $E_1 = 0$. **(08 Marks)**

c. Steam having a specific enthalpy of 2930 kJ/kg flows through a turbine nozzle and after expansion leave the nozzle with an enthalpy 2260 kJ/kg. If the flow is adiabatic determine the exit velocity if (i) the initial velocity is 3600 m/min; (ii) the initial velocity is neglected. **(06 Marks)**

4 a. State and prove carnot theorem. **(06 Marks)**

b. Define Kelvin-Plank and Clausius statements of second law of thermodynamics. **(04 Marks)**

c. Define the following terms: i) Heat engine cycle; ii) Refrigeration effect. **(04 Marks)**

d. An inventor claims that his engine has the following specification. Heating value of the fuel = 74,500 kJ/kg temperature limits 750°C and 25°C. Power developed 75kW fuel burned 0.07kg/min state whether the claim is valid or not. **(06 Marks)**

PART – B

5 a. State and prove Clausius inequality. **(06 Marks)**

b. Starting from first law of thermodynamics. Show that the change in entropy for a reversible isobaric compression process is given by $(s_2 - s_1) = mC_p \log_e \frac{v_2}{v_1}$. **(06 Marks)**

c. $0.04m^3$ of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar calculate:

i) The change in entropy.

ii) The heat flow and

iii) The workdone.

Sketch the process on a p-v and T-s diagram. Assume nitrogen to act as a perfect gas molecular weight (M) of nitrogen is 28. **(08 Marks)**

6 a. Define: i) Triple point; ii) Saturated liquid; iii) Dryness fraction. **(04 Marks)**

b. What is the main objective of quality measurement? With the neat sketch explain throttling calorimeter. **(07 Marks)**

c. Steam at 10 bar and 200°C undergoes a reversible polytropic process to 1 bar according to the law $pv^{1.15} = c$. Determine the final specific volume, the final temperature and heat transferred for the process. **(09 Marks)**

7 a. Write Maxwell's equations and state their importance in thermodynamics. **(06 Marks)**

b. Derive the first and second T-ds equations. **(06 Marks)**

c. Show that for a perfect gas, the difference between the specific heats ($C_p - C_v$) can be expressed as

$$C_p - C_v = \left[p + \left(\frac{\partial u}{\partial v}\right)_T\right]\left(\frac{\partial v}{\partial T}\right)_p = pv\beta + v\beta\left(\frac{\partial u}{\partial v}\right)_T$$

where β is the coefficient of volume expansion. **(08 Marks)**

8 a. Define the following terms:

i) Partial pressure of a gas in a mixture.

ii) Mole fraction of gas.

iii) Mass fraction of a gas. **(06 Marks)**

b. Derive Vander Waal's constants in terms of critical properties. **(06 Marks)**

c. $0.1m^3$ of hydrogen initially at 1.2 MPa, 200°C undergoes a reversible isothermal expansion process to 0.1 MPa. Determine: i) The work done; ii) The heat transfer; iii) Change in enthalpy and iv) Change in entropy. R = 4.124 kJ/kg K. For hydrogen C_p = 14.4 kJ/kg K, C_v = 10.276 kJ/kg K. **(08 Marks)**

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CBCS Scheme

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15ME34/MA34

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

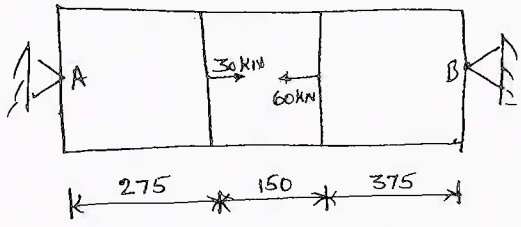
Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain with a neat sketch, stress – strain diagram of mild steel indicating its salient points. **(06 Marks)**

b. A bar of 800mm length is attached rigidly at 'A' and 'B' as shown in fig. Q1(b). Determine the reactions at the two ends, if the bar is 25mm diameter. Find the stresses and change in length in each portion. Take E = 200GPa. **(10 Marks)**

Fig.Q1(b)



OR

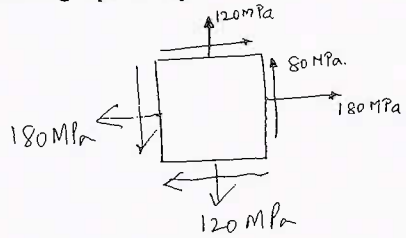
2 a. A bar of brass 25mm diameter is enclosed in a steel tube of 50mm external diameter and 25mm internal diameter. The bar and the tube are rigidly fastened at the ends and are 1.5m long. Find the stresses in the two materials when the temperature raises from 30^0C to 100^0C. Take $E_{steel} = 200kN/mm^2$ $E_{brass} = 100kN/mm^2$ **(08 Marks)**
$\alpha_{steel} = 11.6 \times 10^{-6}/^0C$ $\alpha_{brass} = 18.7 \times 10^{-6}/^0C$.

b. A circular rod of 100mm diameter and 500mm long is subjected to a tensile load of 1000kN. Determine the modulus of rigidity, Bulk modulus and change in volume if Poisson's ratio is 0.3. Take E = 200GPa. **(08 Marks)**

Module-2

3 The state of stress in a two dimensional stressed body is shown in fig.Q3. Determine the principal plane, principal stresses and maximum shear stresses. Sketch the results. Construct the Mohr's circle and verify the answer graphically. **(16 Marks)**

Fig.Q3



OR

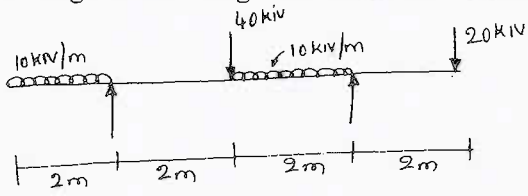
4 a. A thin cylinder 3m long is having 1m internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the cylinder if it is subjected to an internal pressure of $1.5N/mm^2$. **(08 Marks)**

b. A thick cylindrical vessel is 250mm internal diameter and has 50mm thick wall. It is subjected to an internal pressure of 10MPa due to the movement of the fluid. Find the maximum hoop stress developed in the cylinder. Also calculate the radial and hoop stresses at a point 20mm from the inner surface. Sketch the stresses. **(08 Marks)**

Module-3

5 Draw the shear force and bending moment diagrams for the beam shown in fig. Q5. **(16 Marks)**

Fig.Q5



OR

6 a. A cantilever of square section 200mm × 200mm, 2 m long just fails in flexure when a load of 12kN is placed at its free end. A beam of the same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum control point load required to break the beam. **(08 Marks)**

b. Using Double Integration method, determine the slope and deflection for a cantilever beam subjected to concentrated load at free end. **(08 Marks)**

Module-4

7 a. Explain Slenderness ratio. **(04 Marks)**

b. A shaft is required to transmit 245kN power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40MPa and the twist 1^0 per meter length. Determine the diameter required if :

i) the shaft is solid

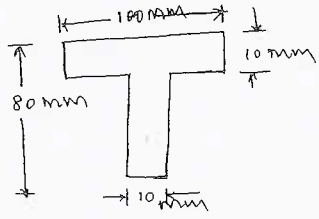
ii) the shaft is hollow with external diameter twice the internal diameter.

Take modules of rigidity. 80kN/mm^2. **(12 Marks)**

OR

8 a. Determine the buckling load for T – section shown below in fig.Q8(a). The column is 3m long and is hinged at both ends. Take E = 200GPa. **(10 Marks)**

Fig.Q8(a)



b. State the assumptions made in Pure torsion theory. **(06 Marks)**

Module-5

9 A bolt is subjected to an axial pull of 12kN together with a transverse shear of 6kN. Determine the diameter of the bolt by using : **(16 Marks)**

i) Maximum principal stress theory ii) Maximum shear stress theory.

Take Elastic limit in tension = 300 N/mm^2 ; Factor of safety = 3 ; Poisson's ratio = 0.3.

OR

10 Write a note on the following :

a. Castigliano's I theorem. **(04 Marks)**

b. Modulus of resilience. **(04 Marks)**

c. Strain energy due to bending and torsion. **(08 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain stress-strain curve with salient points. **(06 Marks)**

b. Obtain an expression extension of a bar with continuously varying rectangular cross section. **(08 Marks)**

c. Determine the reactions at the two ends of the bar if the diameter is 25mm and modulus of elasticity is 200 GPa as shown in the Fig.Q.1(c). **(06 Marks)**

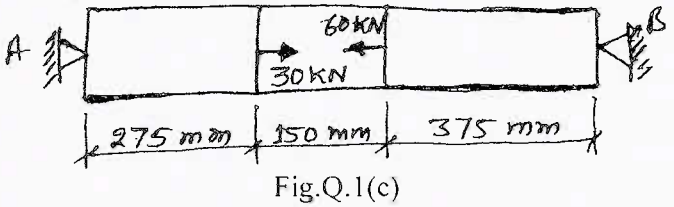

Fig.Q.1(c)

2 a. Derive an equation for volumetric strain for triaxial stress system. **(06 Marks)**

b. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide by 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is one meter. If the temperature is raised by 80°C, determine the stresses in each metal and the change in length. Take E_s = 200GPa, E_c = 100GPa, $\alpha_s = 12 \times 10^{-6}$/°C and $\alpha_c = 17 \times 10^{-6}$/°C. **(14 Marks)**

3 a. State of stress at a point in a strained material with tensile stress of 180 N/mm^2 in x-direction, tensile stress of 120 N/mm^2 in y-direction and shear stress of 80 N/mm^2. Determine:

i) The direction of the principal planes.
ii) The magnitude of principal stresses and
iii) The magnitude of the maximum shear stress and its direction.

Indicate all the above planes by a sketch. **(10 Marks)**

b. The bi-axial stress system subjected to a tensile stress of 60 N/mm^2, compressive stress of 40N/mm^2 in x and y directions respectively and shear stress 10 N/mm^2. Determine using Mohr's circle principal stresses, maximum shear stress and its directions. **(10 Marks)**

4 a. A cylindrical shell is 3m long and is having one meter internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of shell if it is subjected to an internal fluid pressure of 1.5 N/mm^2. Take $E = 2 \times 10^5$Pa and Poissons ratio is 0.3. **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure of 14N/mm^2. Determine the maximum hoop stress developed in the cross section. What is the percentage of error if the maximum hoop stress is found from the equation for thin pipes? **(10 Marks)**

PART – B

5 a. Draw the shear force and bending moment diagrams for the cantilever beam shown in the Fig.Q.5(a). **(08 Marks)**

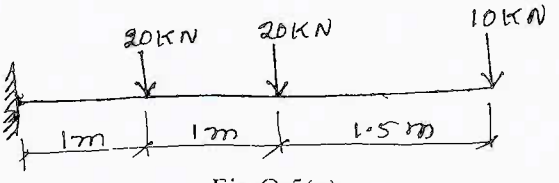

Fig.Q.5(a)

b. For the beam AC shown in the Fig.Q.5(b), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw shear force and bending moment diagrams and locate the point of contra flexure if any **(12 Marks)**

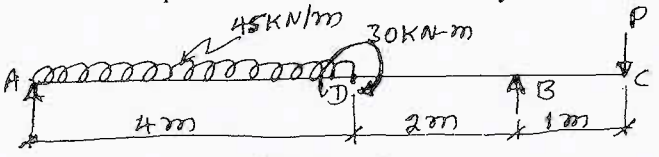

Fig.Q.5(b)

6 a. Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$. **(10 Marks)**

b. A simply supported beam of span 5m has a cross section 150mm × 250mm. If the permissible stress is 10N/mm^2, find: i) maximum intensity of uniformly distributed load it can carry; ii) maximum concentrated load P applied at 2m from an end it can carry. **(10 Marks)**

7 a. Derive deflection equation for a simply supported beam subjected to uniformly distributed load. **(10 Marks)**

b. Determine the deflection at points C, D and E in the beam shown in the Fig.Q.7(b). Take E = 200 kN/mm^2 and I = 60 × 10^6 mm^4. **(10 Marks)**

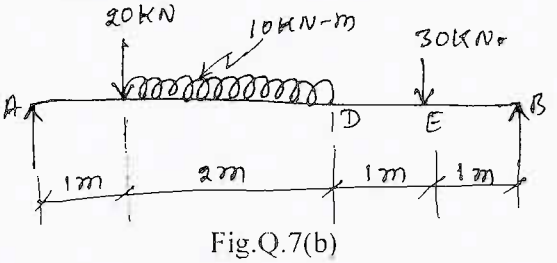

Fig.Q.7(b)

8 a. Derive Euler's equation of a column for both ends hinged. **(10 Marks)**

b. Determine the diameter of solid shaft which will transmit 440kW at 280rpm. The angle of twist must not exceed one degree per metre length and the maximum torsional shear stress is to be limited to 40N/mm^2. Assume G = 84kN/mm^2. **(10 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Manufacturing Processes - I

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Briefly explain the basic steps involved in Sand Casting process. **(05 Marks)**

b. What is Pattern? What are the factors to be considered while selecting a pattern material? **(05 Marks)**

c. What are the additives used in foundry sand? Mention the purpose and percentage of each additive used. **(05 Marks)**

d. Write a brief note on BIS colour coding of patterns. **(05 Marks)**

2 a. Explain briefly the essential requirements of base sand used in foundry. **(05 Marks)**

b. With necessary sketches, explain the following :
i) Balanced core ii) Kiss core. **(05 Marks)**

c. With reference to the gating system, explain the following terms :
i) Riser ii) Pouring basin iii) Runner iv) Sprue and v) Ingate. **(05 Marks)**

d. Write a note on Sand Slinger. **(05 Marks)**

3 a. With a neat sketch, explain sweep moulding process. **(05 Marks)**

b. With necessary sketches, briefly explain the steps involved in the CO_2 moulding process. List the advantages and limitations of the process. **(10 Marks)**

c. Explain squeeze casting technique, with suitable diagram. **(05 Marks)**

4 a. List the factors considered for selecting the melting furnace. **(04 Marks)**

b. With suitable sketch, explain electric resistance furnace. **(06 Marks)**

c. What are the differences between direct and indirect arc furnaces? **(04 Marks)**

d. What are the various zones of Cupola furnace? Write the reactions taking place in each zone. **(06 Marks)**

PART – B

5 a. What are the advantages and disadvantages of welding over other manufacturing processes? **(06 Marks)**

b. With suitable sketch, explain submerged arc welding process. Mention its advantages and limitations. **(08 Marks)**

c. Explain Forward and Backward gas welding techniques. **(06 Marks)**

6 a. Explain the principle of resistance welding. Mention its applications. **(06 Marks)**

b. Explain Seam welding process. **(06 Marks)**

c. With neat sketches, explain friction welding process. Mention its advantages and limitations. **(08 Marks)**

7 a. Explain the measures to minimize the shrinkage in welded joints. **(06 Marks)**

b. What is heat affected zone? Discuss the parameters affecting heat affected zone. **(08 Marks)**

c. Explain different welding defects, their causes and remedies. **(06 Marks)**

8 a. Highlight the differences between Soldering and Brazing. **(05 Marks)**

b. Briefly explain the different fluxes used in soldering. **(06 Marks)**

c. With suitable sketches, explain the various steps involved in the liquid dye penetrate testing of weld components. **(09 Marks)**

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CBCS Scheme

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15ME35A

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define manufacturing process. With a suitable sketch, explain the classification of manufacturing process. **(08 Marks)**

b. What is a pattern? State the functions of a pattern and classify it. **(08 Marks)**

OR

2 a. What do you mean by the term pattern allowance? With a suitable sketch elaborate different types of pattern allowance. **(08 Marks)**

b. Draw and explain the step followed in moduling using sand slinger. **(08 Marks)**

Module-2

3 a. Define furnace, sketch and explain the working principle, constructional feature of induction furnace (corless type). **(08 Marks)**

b. Draw and explain the basic principle of working of a resistance furnace. **(08 Marks)**

OR

4 a. Explain the principle of squeeze casting process with a suitable figure give the setup details. **(08 Marks)**

b. With a neat sketch, explain thixo casting and slush casting. **(08 Marks)**

Module-3

5 a. How are casting defects classified? List out the factors contributing casting defects. **(08 Marks)**

b. Define the term directional solidification. Explain the methods of achieving directional solidification and state the need for directional solidification. **(08 Marks)**

OR

6 a. With a suitable sketch, explain the following terms :
i) Homogeneous nucleation
ii) Heterogeneous nucleation. **(08 Marks)**

b. Define the term degasification. With suitable sketch explain any two methods of degasification. **(08 Marks)**

Module-4

7 a. Define welding process, classify it, list out the applications, advantages and limitations of it. **(08 Marks)**

b. With a suitable sketch explain the principle of resistance welding and classify it. **(04 Marks)**

c. Describe the process of spot welding with a neat sketch. **(04 Marks)**

OR

8 a. Explain how an arc is generated in arc welding. Classify it. With a neat sketch elaborate flux shielded metal arc welding process (FSMAW). **(08 Marks)**

b. Describe the setup of atomic hydrogen welding process with a neat sketch. **(08 Marks)**

Module-5

9 a. Discuss the formation of different zones during welding process. **(08 Marks)**

b. With a neat sketch, explain how crack or discontinuity are inspected in a component using magnetic particle test. **(08 Marks)**

OR

10 a. Draw and explain the types of flames in oxy-acctylene welding process. **(08 Marks)**

b. State the metallurgical aspects in welding process for carbon and high carbon steel. **(08 Marks)**

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CBCS Scheme

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15ME35B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain the classification of machine tools with suitable example. **(08 Marks)**

b. Illustrate the concept of Lathe with a neat sketch. **(08 Marks)**

OR

2 a. Explain the constructional features of plaining machine with a neat sketch. **(08 Marks)**

b. Define drilling. With a neat sketch explain Radial drilling machine. **(08 Marks)**

Module-2

3 a. Define machining of a tool. Explain with a neat sketch of following operations.
- i) Turning
- ii) Boaring
- iii) Shopping. **(08 Marks)**

b. Discuss the related machining parameters of related quantities. **(08 Marks)**

OR

4 a. With a neat sketch explain the concept of Gear cutting. **(08 Marks)**

b. Explain with a neat sketch of following operations :
- i) Broaching
- ii) Reaming
- iii) Grinding
- iv) Countersinking. **(08 Marks)**

Module-3

5 a. Illustrate the desirable properties and characteristics of cutting tool material. **(08 Marks)**

b. Give the concept of tool Geometry and related importance of different angles of the cutting tools. **(08 Marks)**

OR

6 a. What is the necessity of 'coolant'? Explain some of the cutting fluids with their applications. **(08 Marks)**

b. Discuss the machining parameters on surface finish. **(08 Marks)**

Module-4

7 a. With the neat sketch give the description regarding chip formation. **(06 Marks)**

b. Explain two different type of chip formation. **(06 Marks)**

c. Explain the concept of oblique and orthogonal cutting? **(04 Marks)**

OR

8 a. Draw the circle with radius, which gives the merchant circle and derive Ernst –Merchant equation. **(08 Marks)**

b. Draw the share angle relationship and derive the equation

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}$$ **(08 Marks)**

Module-5

9 a. Why the cutting tool will loose its ability? Discuss it with suitable reasons. **(05 Marks)**

b. Define tool wear. Explain craters wear and flank wear. **(07 Marks)**

c. List the factors affecting tool life. **(04 Marks)**

OR

10 Write short notes on the following :

a. Choice of feed

b. Tool tip for minimum cost

c. Minimum production time

d. Choice of cutting speed. **(16 Marks)**

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CBCS Scheme

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15ME36B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define the term metrology. List the objectives of measurement system. **(05 Marks)**

b. Explain line and end standards. **(06 Marks)**

c. Three 100mm end bars measured on a level comparator by first wringing them together and comparing with a 300mm bar. The 300mm bar has a known error of +40μm and the three bars together measure 64μm less than the 300mm bar. Bar A is 18μm longer than bar B and 23μm longer than bar C. Find the actual length of each bar. **(05 Marks)**

OR

2 a. Select the size of angle gauges required to build the following angles, also sketch the arrangement of sample i) 37°16′42″ ii) 35°32′36″ **(06 Marks)**

b. Sketch and explain sine bar. **(04 Marks)**

c. Explain the principle of autocollimeter with the help of a neat sketch. **(06 Marks)**

Module-2

3 a. Explain briefly the different types of fit and show them by neat schematic diagrams. **(08 Marks)**

b. Explain with neat sketch the significance of hole basis and shaft basis system. **(08 Marks)**

OR

4 a. Describe with neat sketch working of LVDT. Also write the advantages and disadvantages of LVDT. **(08 Marks)**

b. With neat sketch describe the construction and working of sigma comparator. **(08 Marks)**

Module-3

5 a. Explain with neat sketch the method of measuring minor diameter of external thread. **(08 Marks)**

b. Explain with neat sketch of Tool maker's microscope. **(08 Marks)**

OR

6 a. Explain with a neat sketch, Gear tooth thickness measurement using gear tooth vernier. **(08 Marks)**

b. Explain with neat sketch the construction and working principle of CMM, also write the applications. **(08 Marks)**

Module-4

7 a. Briefly explain the following terms :
i) Hysteresis ii) Accuracy iii) Precision iv) Threshold. **(08 Marks)**

b. Briefly explain the generalized measurement system with block diagram with an example. **(08 Marks)**

OR

8 a. What is CRO? Explain with sketch the principle and working of CRO. **(10 Marks)**

b. What is Ballast circuit? Explain. **(06 Marks)**

Module-5

9 a. Explain briefly with a neat sketch working of
i) Proving Ring ii) Prone brake dynometer. **(08 Marks)**

b. Explain with neat sketch the working principle of Mclead gauge. **(08 Marks)**

OR

10 a. What are the different methods of strain measurement? Explain mechanical strain gauge. **(08 Marks)**

b. With neat sketch explain the working principle of optical pyrometer. **(08 Marks)**

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10ME36B/AU36B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define following terms:
i) Mass density
ii) Newtonian fluid
iii) Capillarity. **(06 Marks)**

b. Calculate the gauge pressure and absolute pressure within a droplet of water of 0.4cm diameter and a jet of water 0.4cm diameter. Assume surface tension of water as 0.073 N/m and atmospheric pressure as 101300 N/m^2. **(06 Marks)**

c. A flat plate 0.1m^2 area is pulled at 30cm/sec relative to another plate located at a distance of 0.01cm from it, the fluid separating them being water of viscosity 0.001 N-sec/m^2. Find the force and power required to maintain the velocity. **(08 Marks)**

2 a. Define and derive hydrostatic law. **(06 Marks)**

b. Two U-tube manometers, one upright and other inverted type are connected across a water line and on oil line as shown in Fig.Q.2(a). If h_1 = 5cm, then what will be reading h_2? **(06 Marks)**

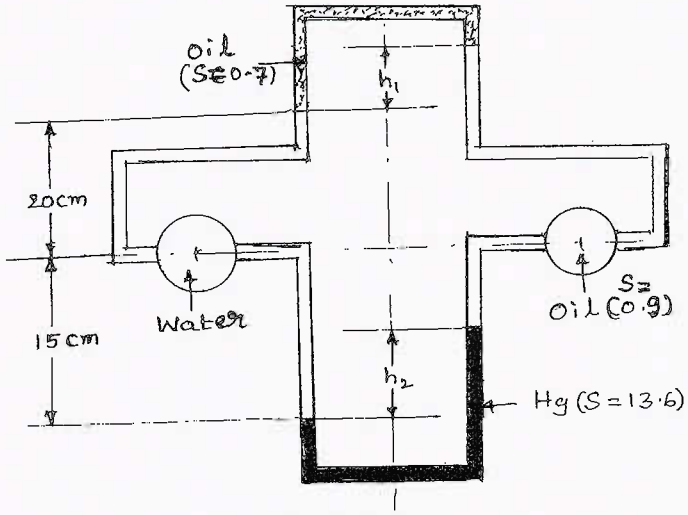

Fig.Q.2(b)

c. A circular plate of 2m in diameter is submerged in oil of special gravity 0.8, such that its greatest and least depths below the free surface are 3.5m and 2m respectively. Find the total pressure on one face of the plate and depth of centre of pressure. **(08 Marks)**

3 a. Write differences between following:
i) Stable and unstable equilibrium of floating bodies.
ii) Steady and unsteady flow.
iii) Stream line and streak line. **(09 Marks)**

b. A cylindrical belay is 2m in diameter, 2.5m long and weighs 21582N. The density of sea water is 1025 kg/m^3 show that the body cannot float with its axis vertical. **(05 Marks)**

c. If for a 2-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at point P(4, 5). Also determine the value of stream function Ψ at point P. **(06 Marks)**

4 a. With suitable assumptions, derive Euler equation of motion along stream line, further reduce it to Bernoulli's equation. **(10 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with diameter at the base 1.2m and at the top 0.6m respectively. The pressure at the upper end is 240mm of Hg (Vaccum), while the pressure at the lower end is 15 kPa. Assume head loss to be 20% of difference in velocity head, calculate the discharge. The flow is vertically upwards and difference in elevation is 3.9m. **(10 Marks)**

PART – B

5 a. Derive equation for actual discharge flowing through V-notch. **(06 Marks)**

b. A pitot static tube is mounted on an airoplane. The plane is flying into still air at a height of 1km, where ambient conditions are P = 0.9 bar and T = 278K. If difference of pressure reading is 0.02 bar, how fast is the plane is going? **(06 Marks)**

c. The lift force F_L on an airfoil depends on the mass density ρ of the medium, velocity of flow v, a characteristic length L, the viscosity μ and angle of attack α (alpha). Obtain an expression for the lift force. **(08 Marks)**

6 a. Derive expressions for Darcy's equation and Chezy's equation for fluid flowing through circular pipe. **(10 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m, when one end of the pipe is connected to tank and other end of pipe is open to the atmosphere. The pipe is horizontal and height of the water in the tank is 4m, above the centre of the pipe. Consider all minor losses and take f = 0.009, also draw HGL and TEL. **(10 Marks)**

7 a. Derive Hagen Poiseulle equation for loss of head due to friction in pipe of length L. **(08 Marks)**

b. A lubricating oil of viscosity 1 poise, and sp. gravity 0.9 is pumped through a 30mm diameter pipe. If the pressure drop per meter length of the pipe is 20kN/m^2. Determine: i) Mass flow rate; ii) The shear stress at the pipe wall; iii) the Reynold's number of flow and iv) The power required per 50m length of the pipe to maintain the flow. **(12 Marks)**

8 a. Define the following terms:
i) Lift; ii) Drag; iii) Displacement thickness; iv) Energy thickness; v) Mach number. **(15 Marks)**

b. A projectile travels in air of pressure 1.01043×10^5N/m^2 at 10°C at a speed of 1500km/hr. Find Mach number and Mach angle. Take K = 1.4 and R = 287 J/kg K. **(05 Marks)**

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15ME36B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define the term metrology. List the objectives of measurement system. **(05 Marks)**

b. Explain line and end standards. **(06 Marks)**

c. Three 100mm end bars measured on a level comparator by first wringing them together and comparing with a 300mm bar. The 300mm bar has a known error of +40μm and the three bars together measure 64μm less than the 300mm bar. Bar A is 18μm longer than bar B and 23μm longer than bar C. Find the actual length of each bar. **(05 Marks)**

OR

2 a. Select the size of angle gauges required to build the following angles, also sketch the arrangement of sample i) 37°16′42″ ii) 35°32′36″ **(06 Marks)**

b. Sketch and explain sine bar. **(04 Marks)**

c. Explain the principle of autocollimeter with the help of a neat sketch. **(06 Marks)**

Module-2

3 a. Explain briefly the different types of fit and show them by neat schematic diagrams. **(08 Marks)**

b. Explain with neat sketch the significance of hole basis and shaft basis system. **(08 Marks)**

OR

4 a. Describe with neat sketch working of LVDT. Also write the advantages and disadvantages of LVDT. **(08 Marks)**

b. With neat sketch describe the construction and working of sigma comparator. **(08 Marks)**

Module-3

5 a. Explain with neat sketch the method of measuring minor diameter of external thread. **(08 Marks)**

b. Explain with neat sketch of Tool maker's microscope. **(08 Marks)**

OR

6 a. Explain with a neat sketch. Gear tooth thickness measurement using gear tooth vernier. **(08 Marks)**

b. Explain with neat sketch the construction and working principle of CMM, also write the applications. **(08 Marks)**

Module-4

7 a. Briefly explain the following terms :
i) Hysteresis ii) Accuracy iii) Precision iv) Threshold. **(08 Marks)**

b. Briefly explain the generalized measurement system with block diagram with an example. **(08 Marks)**

OR

8 a. What is CRO? Explain with sketch the principle and working of CRO. **(10 Marks)**

b. What is Ballast circuit? Explain. **(06 Marks)**

Module-5

9 a. Explain briefly with a neat sketch working of
i) Proving Ring ii) Prone brake dynometer. **(08 Marks)**

b. Explain with neat sketch the working principle of Mclead gauge. **(08 Marks)**

OR

10 a. What are the different methods of strain measurement? Explain mechanical strain gauge. **(08 Marks)**

b. With neat sketch explain the working principle of optical pyrometer. **(08 Marks)**

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06ME43

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Use of Thermodynamics data hand book is allowed.*

PART – A

1 a. With a neat sketch, explain the Orsat apparatus. **(10 Marks)**

b. The percentage composition of a fuel on mass basis is as follows:
$C = 90$; $H_2 = 3.5$; $O_2 = 1$; $S = 0.5$ and ash = 5
Calculate :
(i) The minimum air required for complete combustion of 1 kg of fuel.
(ii) The composition of dry flue gases on mass basis if 50% excess air is supplied. **(10 Marks)**

2 a. Derive an expression for air-standard efficiency of diesel cycle. Show the P-V and T-S plots. **(10 Marks)**

b. An engine working on the Otto cycle is supplied with air at 0.1 MPa , 35°C. The compression ratio is 8. Heat supplied is 2100 KJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency, and the mean effective pressure. For air, $C_p = 1.005$, $C_v = 0.718$ and $R = 0.287$ KJ/kg.K. **(10 Marks)**

3 a. With a neat sketch, explain Turbojet. **(08 Marks)**

b. In a gas turbine plant, working on Brayton cycle with a regenerator of 75% effectiveness, the air at the inlet to the compressor is at 0.1 MPa, 30°C, the pressure ratio is 6, and the maximum cycle temperature is 900°C. If the turbine and compressor have each an efficiency of 80%, find the percentage increase in the cycle efficiency due to regeneration. **(12 Marks)**

4 a. Explain the effect of. (i) Superheat on mean temperature of heat addition. (ii) Increase in pressure on Rankine cycle. **(08 Marks)**

b. A cyclic steam power plant is to be designed for a steam temperature at turbine inlet at 360°C and an exhaust pressure of 0.08 bar. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition. **(12 Marks)**

PART – B

5 a. Derive an expression for workdone per kg of air delivered by a reciprocating air compressor (without clearance). **(08 Marks)**

b. A single cylinder, single acting air compressor is required to deliver 5 m^3 of free air per minute at a mean piston speed of 150 m/min. The air compressed from 1 bar to 7 bar. The Clearance is $\frac{1}{15}^{th}$ of the stroke and the stroke is 1.25 times the diameter. Assuming the index of compression and expansion 1.3 and suction and ambient conditions are same, Find
(i) The volumetric efficiency.
(ii) The speed in rpm.
(iii) The power required if the mechanical efficiency is 85%
(iv) Diameter and stroke of the piston. **(12 Marks)**

6 a. Explain the principle working of vapour absorption refrigeration system. **(10 Marks)**

b. An NH_3 refrigerator operates between evaporating and condensing temperature of $-16^{\circ}C$ and $+50^{\circ}C$ respectively. The vapour is dry saturated at the compressor inlet, the compression process is isentropic and there is no under cooling of the condensate. Calculate,

i) The refrigeration effect / kg.

ii) The mass flow and power input / ton of refrigeration.

iii) COP of the refrigerator. C_{PV} at $50^{\circ}C = 3.00$ KJ/kgK. **(10 Marks)**

7 a. Define: (i) Dry bulb temperature (DBT) (ii) Wet bulb temperature (WBT)
(iii) Dew point temperature (DPT) (iv) Specific humidity.
(v) Degree of Saturation. **(10 Marks)**

b. For a hall to be air-conditioned, the following conditions are given,
Outdoor condition - $40^{\circ}C$ DBT, $20^{\circ}C$ WBT
Required comfort condition - $20^{\circ}C$ DBT, 60% RH
Seating capacity of Hall – 1500
Amount of outdoor air supplied – 0.3 m^3/min per person.
If the required condition is achieved first by adiabatic humidification and then by cooling, estimate,

i) The capacity of cooling coil in tons and

ii) The capacity of the humidifier in kg/hr. **(10 Marks)**

8 a. Explain the following:

(i) Morse test

(ii) Willian's lire method. **(08 Marks)**

b. The following observations were recorded in a test of one hour duration on a single cylinder oil engine working on four stroke cycle.
Bore = 300 mm, Stroke = 450 mm, Fuel used = 8.8 kg, CV of fuel = 41,800 KJ/kg. Average speed = 200 rpm, MEP = 5.8 bar, Brake friction load = 1860 N, Dia of broke wheel = 1.22 m.
Calculate,

(i) Mechanical efficiency

(ii) Brake thermal efficiency

(iii) BSFC

(iv) BMEP. **(12 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017

Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamic data handbook and charts is permitted.

PART – A

1 a. Explain the following terms with reference to a combustion process:
i) Enthalpy of formation ii) Adiabatic flame temperature
iii) Enthalpy of combustion iv) Heat of reaction **(08 Marks)**

b. The products of combustion of an unkown hydrocarbon C_xH_y have the following composition as measured by an orsat apparatus: CO_2 = 8.0%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine,
i) The composition of the fuel,
ii) The air fuel ratio,
iii) The percent excess air used. **(12 Marks)**

2 a. Derive with usual notations an expression for the air standard efficiency of a diesel cycle. Represent the cycle on P-V and T-S diagrams. **(10 Marks)**

b. An engine working on the otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of air. The pressure and temperature of air at the beginning of compression are 0.1 MPa and 60°C respectively. Compute:
i) The compression ratio
ii) The work done/kg of air
iii) The pressure and temperature at the end of compression,
iv) The maximum pressure in the cycle. **(10 Marks)**

3 a. Describe Morse test. What are the assumptions made in this test? **(08 Marks)**

b. A gas engine working on constant volume cycle the following results during a one hour test run. Cylinder diameter 24 cm, stroke 48 cm, effective diameter of brake wheel 1.25 m. Net load on brake 1236 N. Average speed 226.7 revolution per minute. Average explosions per minute 77, MEP 7.5 bar, gas used 13 m^3 at 15°C and 771 mm of mercury pressure. Lower calorific value of gas 22000 kJ/m^3 at NTP. Cooling water used 625 kg. Rise in temperature of cooling water 35°C. NTP conditions are 760 mm of Hg and 0°C. Determine:
i) Mechanical efficiency
ii) The specific fuel consumption in m^3/I.P. hour.
iii) Indicated and brake thermal efficiencies.
Draw up a heat balance for the engine on minute basis. **(12 Marks)**

4 a. Explain the effect of: i) Maximum pressure, ii) Exhaust pressure, iii) Superheat, on the simple Rankine cycle. **(06 Marks)**

b. A regenerative cycle operates with steam supplied at 30 bar and 300°C and condenser of 0.08 bar. The extraction points for two heaters (open type) are at 3.5 bar and 0.7 bar. Calculate thermal efficiency of the plant, neglecting pump work. Show the T-S diagram. **(14 Marks)**

PART – B

5 a. Obtain an expression for the volumetric efficiency of a single stage air compressor in terms of pressure ratio, clearance and 'n' the polytropic index. **(06 Marks)**

b. Why inter-cooling is necessary in multistage compression? **(04 Marks)**

c. A two stage air compressor with perfect inter-cooling takes in air at 1 bar and 27°C. The law of compression in both the stages is $pu^{1.3}$ = constant. The compressed air is delivered at 9 bar. Calculate for unit mass flow rate of air the minimum work done and the heat rejected to inter-cooler. Compare the values if compression is carried out in single stage compressor with after-cooler. **(10 Marks)**

6 a. Explain how inter-cooling increases thermal efficiency of gas turbine plant with block diagram and T-S diagram. **(06 Marks)**

b. With a neat sketch, explain working of Ramjet. **(04 Marks)**

c. A gas turbine power plant operates on the simple Brayton cycle with air as the working fluid and delivers 32 MW of power. Minimum and maximum temperatures in the cycle are 310 K and 900 K, and the pressure of air at the compressor exit is 8 times the value at the compressor inlet. Assuming an isentropic efficiency of 80% for the compressor and 86% for the turbine, determine the mass flow rate of air through the cycle. **(10 Marks)**

7 a. Draw a neat diagram of vapour-absorption refrigeration system with auxiliaries to improve its performance. Explain its principle of working briefly. **(08 Marks)**

b. Write a brief note on properties of refrigerants. **(04 Marks)**

c. An ammonia vapour compression refrigerator works between an evaporator pressure of 1.2 bar and a condenser pressure of 12 bar. The refrigerant leaves the evaporator at –20°C and leaves the condenser at +20°C. Determine the COP of the system and the power required per ton of refrigeration. **(08 Marks)**

8 a. Define the following terms:
   i) Dry bulb temperature (DBT)
   ii) Wet bulb temperature (WBT)
   iii) Specific humidity (SH)
   iv) Relative humidity (RH)
   v) Degree of saturation (DS) **(10 Marks)**

b. For a hall to be air-conditioned, the following conditions are given:
Outdoor conditions 40°C DBT, 20°C WBT
Required comfort conditions 20°C DBT, 60% RH
Seating capacity of hall = 1500
Amount of outdoor air supplied 0.3 m^3/min per person.
If the required condition is achieved first by adiabatic humidification and then by cooling, estimate:
   i) Capacity of the cooling coil in tonnes, and
   ii) The capacity of the humidifier in kg/hr. **(10 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017

Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define with suitable examples:
i) Structure ii) Machine
iii) Mechanism iv) Lower pair **(08 Marks)**

b. Sketch and explain the inversions of double slider crank chain. **(12 Marks)**

2 a. Sketch and explain the crank and slotted lever mechanism. **(06 Marks)**

b. Sketch and explain Geneva wheel mechanism. **(07 Marks)**

c. Sketch Ackerman steering mechanism and obtain condition for correct steering. **(07 Marks)**

3 a. Define the following:
i) Linear and angular velocity.
ii) Linear and angular acceleration **(06 Marks)**

b. The crank of a slider crank mechanism is 480 mm long and rotates uniformly at 20 rad/sec in the counter clockwise direction. It has a connecting rod of 1600 mm long. Determine the following when the crank is at 60° from the inner dead centre.
i) Velocity of slider
ii) Angular velocity of connecting rod and
iii) The position and velocity of a point 'p' on the connecting rod having least absolute velocity. **(14 Marks)**

4 a. Define instantaneous centre and state the types of instantaneous centres. **(04 Marks)**

b. In a slider crank mechanism the crank OA = 300 mm and connecting rod AB = 1200 mm. The crank OA is turned 30° from inner dead centre. Locate all the instantaneous centres. If the crank rotates at 15 rad/sec clockwise, find: i) velocity of slider, B; ii) angular velocity of connecting rod AB. **(08 Marks)**

c. Explain Klein's construction for slider-crank mechanism. **(08 Marks)**

PART – B

5 Using complex algebra, derive expression for velocity and acceleration of the piston and angular acceleration of connecting for a reciprocating engine mechanism. Use these expressions to find the above, if the crank length is 50 mm, connecting rod is 200 mm long, crank angle is 30°, the crank rotates at a constant speed of 3000 rpm. **(20 Marks)**

6 a. Compare cycloidal and involute gear tooth profile. **(04 Marks)**

b. Derive an equation to determine the length of path of contact by a pair of mating spur gear. **(08 Marks)**

c. Two mating gears with module pitch 6 mm have 20 and 50 teeth of pressure angle 20° and addendum 6 mm. Determine the number of pairs of teeth in contact. **(08 Marks)**

7 a. Sketch and explain:
   i) Compound gear train,
   ii) Epicyclic gear train. **(06 Marks)**

   b. A fixed annular gear A and a smaller concentric rotating gear B are connected by a compound gear C and D. The gear C mesh with gear A and D with B. The compound gears revolved in a pin on the arm R, which revolves about the axis of A and B. The number of teeth on gears A, B and D are 150, 40 and 100 respectively. Determine the number of teeth on gear C, if the gear A and C have twice the module of gear B and D. How many revolutions will B make for one complete revolution of the arm R? **(14 Marks)**

8 The following data relate to a cam profile in which the follower moves with UARM during ascent and descent.
Minimum radius of the cam = 25 mm
Roller diameter = 10 mm
Lift = 30 mm
Offset of follower axis = 10 mm towards right
Angle of ascent = 60°
Angle of descent = 90°
Angle of dwell between ascent and descent = 45°
Speed of the cam = 200 rpm
Draw the profile of the cam. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. With neat sketches, explain the different types of chips produced during metal cutting. **(06 Marks)**

b. Draw Merchant's circle diagram and derive the Ernst-Merchant's solution, $2\phi + \beta - \alpha = \pi/2$ where ϕ = shear plane angle, β = friction angle, α = rake angle. **(10 Marks)**

c. While turning a mild steel rod with a HSS tool, a tool life of 15min was obtained at the cutting speed of 400m/min. When the cutting speed was reduced to 200m/min, tool life obtained was 90min. Determine the constants in the tool life equation. **(04 Marks)**

2 a. Explain the properties that are to be considered during the selection of a cutting tool material. **(08 Marks)**

b. Briefly explain the different types of cutting fluids. **(06 Marks)**

c. With a neat sketch, explain the zones of heat generation in metal cutting. **(06 Marks)**

3 a. With a neat sketch, explain the constructional feature of a turret lathe. **(10 Marks)**

b. With a neat sketch, explain open and cross belt drive mechanism of a planer. **(10 Marks)**

4 a. With a neat sketch, explain the constructional features of a radial drilling machine tool. **(08 Marks)**

b. With neat sketches explain any four operations performed on a drilling machine tool. **(08 Marks)**

c. Differentiate between absolute coordinate system and incremental coordinate system. **(04 Marks)**

PART – B

5 a. With a neat sketch, explain the constructional features of a horizontal spindle column and knee milling machine tool. **(10 Marks)**

b. Show the calculations to index 51 divisions by compound indexing method on a universal dividing head. Consider a index plate with circles of holes – 15, 16, 17, 18, 19, 20. **(10 Marks)**

6 a. Write a note on grade and structure of grinding wheel. **(05 Marks)**

b. With a neat sketch, explain the constructional features of a centreless grinding machine. **(09 Marks)**

c. Explain the factors to be considered while selecting a grinding wheel. **(06 Marks)**

7 a. With a neat sketch, explain the constructional features of a continuous surface broaching machine. **(08 Marks)**

b. With a neat sketch, explain the principle of lapping. **(06 Marks)**

c. With a neat sketch, explain the principle of honing. **(06 Marks)**

8 a. With a neat sketch, explain the working principle of ultrasonic machining process and state its advantages. **(10 Marks)**

b. With a neat sketch, explain the working principle of electron beam machining process and state its advantages. **(10 Marks)**

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10ME46B/AU46B

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define the following fluid properties:
   i) Density
   ii) Weight density
   iii) Specific volume
   iv) Specific gravity
   v) Surface tension. **(05 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a liquid. **(08 Marks)**

c. A vertical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120rpm. **(07 Marks)**

2 a. State and prove the Pascal's law. **(10 Marks)**

b. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(10 Marks)**

3 a. Explain the following terms:
   i) Buoyancy
   ii) Centre of Buoyancy
   iii) Meta centre
   iv) Meta centric height. **(04 Marks)**

b. A cylindrical body is 2m in diameter, 2.5m long and weighs 2.2 metric tonnes. The density of sea water is 1025 kg/m^3. Show that the body cannot float with its axis vertical. **(06 Marks)**

c. Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(10 Marks)**

4 a. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(10 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2. If the diameters at the upper and lower ends are 15cm and 10cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

PART – B

5 a. What is a venturimeter? Derive an expression for discharge through a venturimeter. **(10 Marks)**

b. Using Backingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$.

Where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(10 Marks)**

6 a. How will you determine the loss of head due to friction in pipes by using:
i) Darcy formula and ii) Chezy's formula. **(10 Marks)**

b. Three pipes of 400mm, 200mm and 30mm diameters have lengths of 400m, 200m and 300m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16m. If co-efficient of friction for these pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. **(10 Marks)**

7 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(12 Marks)**

b. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:
i) The pressure gradient
ii) The average velocity and
iii) Reynold number of the flow. **(08 Marks)**

8 a. Explain lift and drag. **(06 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50km/hour in a stationary air of density 1.15kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively, determine:
i) The lift force
ii) The drag force
iii) The resultant force
iv) The power required to keep the plate in motion. **(08 Marks)**

c. Find the velocity of bullet fired in standard air if the mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Material Science & Metallurgy

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What is atomic packing factor? Calculate APF for FCC structure. **(10 Marks)**

b. What is diffusion? Write the Fick's first law of diffusion also benefits of diffusion. **(06 Marks)**

c. Write the difference between edge dislocation and screw dislocation. **(04 Marks)**

2 a. Explain the following:
(i) Secant modulus (ii) Tangent modulus (iii) Resilience. **(06 Marks)**

b. Explain with neat sketch of Vicker hardness test. **(04 Marks)**

c. A 12.5 mm dia aluminium alloy test bar is subjected to a load of 2 tons. If the dia of the bar is 12.4 mm at this load, calculate engineering stress and strain, true stress and true strain. Assume no change in volume. **(10 Marks)**

3 a. What is fracture? Explain different types of fracture. **(04 Marks)**

b. Explain with neat sketch of RR Moore fatigue test with S-N curve of mild steel and Al alloy. **(10 Marks)**

c. Explain different types of mechanism used in Creep. **(06 Marks)**

4 a. Write GIBB's phase rule, also write the phase and DOF. **(04 Marks)**

b. Explain with neat sketch of solid solution phase diagram for Ni-Cu. **(06 Marks)**

c. What is Nucleation? Explain briefly homogeneous and heterogeneous nucleation. **(10 Marks)**

PART – B

5 a. Draw the iron-carbon equilibrium diagram and explain briefly. **(10 Marks)**

b. With neat sketch, explain TTT diagram for hypo-eutecoid and hyper-eutecoid steel. **(10 Marks)**

6 a. Explain briefly Jominy-End quench test. **(08 Marks)**

b. Differentiate normalizing and annealing. **(06 Marks)**

c. Explain with neat sketch of flame hardening process. **(06 Marks)**

7 a. Explain with micro structure of different types of carbon steels. **(10 Marks)**

b. Write the characteristics, applications and types of Titanium alloys. **(10 Marks)**

8 a. What is composite material? Discuss the roles of the matrix and reinforcements in a composite material. **(10 Marks)**

b. What are the advantages, disadvantages and applications of composite materials? **(10 Marks)**

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10ME/AU42B

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What is metrology? Explain with necessary sketch the imperial standard yard and high light the significance of Airy points. **(09 Marks)**

b. Four length bars A, B, C, D of approximately 250mm each are to be calibrated with standard metre bar which is actually 0.0008mm less than a metre. It is also found that bar B is 0.0002mm longer than bar A. Bar 'C' is 0.0004mm longer than bar A and bar D is 0.0001mm shorter than bar A. **(07 Marks)**

c. Build up slip gauges for 92.357mm. **(04 Marks)**

2 a. Explain briefly the difference between the inter changeable manufacture and selective assembly. **(04 Marks)**

b. Calculate the dimensions of plug and ring gauges to control the production of 50mm shaft and hole pair of H_7d_8 as per IS specifications. The following assumptions may be made: 50mm lies in diameter step of 30 to 50mm and the upper deviation for 'd' shaft is given by $-16\ D^{0.44}$ and lower deviation for hole H is zero. Tolerance unit i(micron) = $0.45\sqrt[3]{D} + 0.001D$ and IT6 = 10i above IT6 grade the tolerance magnitude is multiplied by 10 at each fifth step. **(16 Marks)**

3 a. Explain with necessary sketch the working principle of solex pneumatic comparator. **(08 Marks)**

b. List the advantages and disadvantages of mechanical comparator. **(05 Marks)**

c. Explain with neat sketches the use of sine bar for measuring known and unknown angles. **(07 Marks)**

4 a. Explain the procedure to measure the tooth thickness of a spur gear using a gear tooth vernier caliper. **(08 Marks)**

b. Explain with necessary sketch the working principle of optical flat. **(06 Marks)**

c. Derive an expression for best size wire. **(06 Marks)**

PART – B

5 a. Differentiate between accuracy and precision. **(04 Marks)**

b. Explain with necessary block diagram the elements of generalized measurement system. **(08 Marks)**

c. Explain the following with respect to measuring instrument: i) Calibration; ii) Threshold; iii) Sensitivity; iv) Hysterisis. **(08 Marks)**

6 a. Explain the inherent problems observed in mechanical type intermediate modifying devices. **(06 Marks)**

b. Explain with necessary circuit the following electrical intermediate modifying devices: i) Input circuitry; ii) The Ballast circuit. **(08 Marks)**

c. With a neat sketch explain the working of oscillograph. **(06 Marks)**

7 a. With a neat sketch, explain the working principle of analytical balance. **(08 Marks)**

b. Explain with a neat sketch the working of hydraulic dynamometer. **(08 Marks)**

c. Explain with a neat sketch the working of proving ring. **(04 Marks)**

8 a. Explain two laws of thermocouple governing the working of thermocouple. **(06 Marks)**

b. Explain with basic wheat stone bridge circuit the methods of strain measurement. **(08 Marks)**

c. Explain the steps in strain gauge mounting. **(03 Marks)**

d. What is gauge factor? **(03 Marks)**

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