

Enrolment No.

S4UPE04B11PE

B-TECH 4th SEM ENDTERM EXAMINATION, 2018

Subject Name: Engineering Materials,

Subject Code: UPE04B11

Full Mark: 100

Time: 3 hours

Answer all the questions.

1. Explain Gibbs Phase rule with a phase diagram of pure Magnesium. (10)
2. With a neat sketch a iron carbon phase diagram and label all the plausible phases. (10)
3. Explain the mechanism of Martensite formation with help of continuous cooling transformation curves. (10)
4. Explain the properties and applications of the following ceramics:
a) Alumina b) Silicon Nitride c) SiALON d) Zirconia and Partially stabilized Zirconia (20)
5. Write notes on a) Fiber Reinforced Composite (FRC) b) Particle Reinforced composite (PRC) c) Polymer Matrix Composite (PMC) (15)
6. What are intermetallics? Explain their properties, applications with examples. (5)
7. What are the three methods of carburizing that are commonly employed? Explain in detail. (10)
8. How do you define a fracture in a metal or an alloy? Explain the salient of ductile fracture. (10)
9. What are superalloys? Classify superalloys based on the major alloying element. (2+3)
10. What are shape memory alloys? Describe different types of shape memory effects (2+3)

Case handling
polydimethylsiloxane

SiC
MgO/SiO₂

SiALON

AlN
2Co₂ → C + 2Co
Co → 2Co

AlN
MgO/SiO₂
C + Co₂ → 2Co
Co → Co₂

Answer any five questions

- (a) What is thermal conductivity and diffusivity? (b) Prove that, Thermal flux- $q = K_a (T_1 - T_2) / L$.
A furnace wall is made-up of three layers, one of fire brick, second one insulating brick and last one of red brick. The temperatures of inner and outer surface are 1000°C and 45°C respectively. The co-efficient of thermal conductivities are 0.45, 0.24 and 0.65 W/MK of the different layers respectively. The thicknesses of the different walls are 25CM, 15CM and 10CM respectively. Find the rate of heat lost and inter surface temperature of the walls.
(d) Prove that 3-D heat flow equation- $\partial T / \partial x^2 + \partial T / \partial y^2 + \partial T / \partial z^2 = 0$ For steady flow energy equation. 4+4+4+8 = 20
2. (a) What is governing and throttling in steam engine? What are the limitations of single cylinder steam engine? (b) Deduce the expression of mean effective pressure of single cylinder steam engine with clearance volume. (c) What are the basic differences between impulses to reaction steam turbine? What are the advantages of steam turbine to steam engine? (d) What is degree of reaction and reheat factor? The single cylinder double acting of a non-condensing without clearance steam engine is supplied with superheated steam at a pressure of 16 bar. The cut-off takes place at 0.45 of the stroke. The back pressure is 1.25 bar. If the stroke is 1.25 times of the bore and power develops 75 KW at 60rpm of the engine. Find the steam consumption rate. 5+5+4+6 = 20
3. (a) What is free and forced convection? Define Prandtl and Nusselt No.? Prove that, $Pe = Re \times Pr$. Where, Pe is the Peclet No. Re is the Reynolds no. and Pr is the Prandtl no. (b) Hot air at 300°C flows through 30cm diameter horizontal pipe which is exposed to atmosphere at 25°C. Calculate the heat lost to the atmosphere per meter. Assume length of the by natural convection from outside of the surface. Properties of air at mean temperature, $\rho = 0.815 \text{ kg/m}^3$, $C_p = 1.019 \text{ KJ/Kg}$, $K = 0.035 \text{ W/MK}$, $\mu = 24.25 \times 10^{-6} \text{ Kg/m}^2 \cdot \text{sec}$. (c) Define, absorptivity, transmissibility and reflectivity. What is heat exchanger and fouling? 8+5+7 = 20
4. (a) Write a note on Impulse Turbine. (b) The velocity of steam, leaving the nozzles of an impulse turbine, is 1600 m/s and the nozzle angle is 25°. The blade velocity is 400 m/s and the blade velocity coefficient is 0.80. Assuming no loss due to shock at inlet, calculate for a mass flow of 0.5 kg/s and symmetrical blading: (i) blade inlet angle; (ii) driving force on the wheel; (iii) axial thrust on the wheel; and (iv) power developed by the turbine. (c) Derive an equation for height of turbine. Define blade velocity coefficient. 6+8+6 = 20
5. (a) Prove that degree of reaction of Parson's reaction Turbine is 50%. (b) A reaction turbine runs at 300 r.p.m. and its steam consumption is 15400 kg/h. The pressure of steam at a certain pair is 1.9 bar; its dryness 0.93 and power developed by the pair is 3.5 kW. The discharging blade tip angle is 20° for both fixed and moving blades and the axial velocity of flow is 0.72 of the blade velocity. Find the drum diameter and blade height. Take the tip leakage steam as 8% but neglect blade thickness. (c) Define Scavenging of IC Engine. What are the different types of Scavenging? Discuss them with diagram. 5+10+5 = 20
6. (a) Write a note on Friction in a Nozzle. (b) Draw an equation for maximum discharge through a Nozzle. (c) Steam at a pressure of 10 bar and 210°C is supplied to a convergent divergent nozzle with a throat area of 1500 mm². The exit is below critical pressure. Find the coefficient of discharge, if the flow is 7200 kg of steam per hour. (d) Derive an equation for diameters of Throat and Exit for Maximum Discharge. 4+8+4+4 = 20

Time: 3 hrs

Full Marks: 100

The figures in the margin indicate full marks for the questions

Answer all the Questions

1.
 - a. What are the different data types used in C++? Briefly explain their features.
 - b. Distinguish between break and continue statement.
 - c. Describe briefly any two functions used for file operations.
 - d. Differentiate between call by value and call by reference. (2.5+2.5+2.5+2.5)
2.
 - a. Determine the spacing h in a table of equally spaced values of the function $y = \sqrt{x}$ between 1 and 2 so that the interpolation with a second degree polynomial in this table will yield a desired accuracy $\epsilon = 10^{-6}$.
 - b. How are characters handled in C++ programming? (5 + 5)
3.
 - a. Find a real root of the equation $3x - \cos x - 1 = 0$ using *secant* method, correct up to 3 decimal places.
 - b. What are transcendental equations? (8 + 2)
4.
 - a. Explain the concept of successive approximation method.
 - b. Explain the "for" statement with syntax and example. (5+5)
5. Evaluate, by using (i) the Trapezoidal rule, (ii) Simpson's 1/3rd rule and (iii) Simpson's 3/8th rule $y = \int_0^6 \frac{x \, dx}{1+x^2}$, taking $n = 12$ (10)
6. Solve the BVP: $y'' + 2y' + y = 0$, $y(0) = 0$, $y(1) = 1$; using finite difference method taking
 - (i) $h = 0.25$ and (ii) $h = 0.125$ (10)

7. a. Find the inverse of the matrix $A = \begin{bmatrix} 6 & -4 & 0 \\ -4 & 8 & -4 \\ 0 & -4 & 6 \end{bmatrix}$ by Gauss-Jordan method (5)

b. Write a program in C to implement Runge-Kutta method.

(10)

8. a. Using the Runge-Kutta method of fourth-order, solve $\frac{dy}{dx} = (y^2 - x^2) / (y^2 + x^2)$ with $y(0) = 1$ at $x = 0.2, 0.4, 0.6, 0.8, 1.0$.

b. Cross-sectional area of piston cylinder corresponding to various values of diameter is tabulated below:

Diameter (d)	80	85	90	95	100
Area (A)	5062	5674	6362	7088	7854

Using Lagrangian interpolation formula, determine the area of cylinder having diameter 80 mm.

(7+3)

P.T.O

9. a. Determine the largest eigen-value and the corresponding eigen-vector of the following matrix:

$$\begin{bmatrix} 20 & 1 & 2 \\ 1 & 3 & 5 \\ 3 & 0 & -5 \end{bmatrix}$$

correct up to two significant figures by power method.

- b. How can you correlate Trapezoidal and Simpson's $1/3^{\text{rd}}$ formula with Newton's Forward difference formula? (5 + 5)

10. Find a cubic polynomial which takes the following set of values (1, 2), (2, 4), (3, 6) and (4, 10). (5)

Enrolment No. 1604E032

B.Tech 4th Semester End term Examination, 2018

Department of Production Engineering

Subject Name: Mechanics of Machines

Paper code: UPE05B12

SSUPE05B12PE05

Full Marks: 100

Time: 3 hours

Answer any 3 question from Part A and any 5 question from Part B

Part A

1. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 70° and C to D 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitude and angular positions. (15)
2. The lengths of crank and connecting rod of a vertical reciprocating engine are 300 mm and 1.5 m respectively. The crank is rotating 200 rpm clockwise. Find analytically, I) Acceleration of piston, II) Velocity of piston and III) Angular acceleration of the connecting rod when the crank has turned through 40° clockwise from the top dead centre and piston is moving down words. (5+5+5)
3. For the above problem (given in Question No. Part A - 2) find the velocity of the piston at that instant by instantaneous center method. Also for the same problem, find the acceleration of the piston for the above problem graphically. (5+10)
4. The lengths of crank and connecting rod of a horizontal steam engine are 120 mm and 600 mm respectively. The crank is rotating at 450 rpm. The average frictional resistance of the motion of piston is equivalent to a force of 600 N and net effective steam pressure on piston is 500 kN/m². The diameter of piston is 0.3 m and mass of reciprocating parts is 170 Kg. When the crank has turned 40° from the inner dead centre, find analytically torque on the crank shaft. (15)

Part B

5. For a flat belt, prove that $\frac{T_1}{T_2} = e^{\mu\theta}$

where T_1 = Tension in the tight side of the belt, T_2 = Tension in the slack side of the belt, μ = Coefficient of friction between the belt and the pulley, and θ = Angle of contact between the belt and the pulley (in radians.) (11)

6. An epicyclic gear consists of three gears A, B and C as shown in Fig. 1. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m. If the gear A is fixed, determine the speed of gears B and C. (11)

7. The simple band brake, as shown in Fig. 2, is applied to a shaft carrying a flywheel of mass 400 kg. The radius of gyration of the flywheel is 450 mm and runs at 300 r.p.m. If the coefficient of friction is 0.2 and the brake drum diameter is 240 mm, find : (A) the torque applied due to a hand load of 100 N, (B) the number of turns of the wheel before it is brought to rest, and (C) the time required to bring it to rest, from the moment of the application of the brake. (11)

8. A single block brake is shown in Fig. 3. The diameter of the drum is 250 mm and the angle of contact is 90° . If the operating force of 700 N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.35, determine the torque that may be transmitted by the block brake. (11)

9. Neglecting collar friction and considering only screw friction, derive an expression for the effort required to raise a load at the end of the handle of a screw jack. (11)

10. The pitch of 50 mm mean diameter threaded screw of a screw jack is 12.5 mm. The coefficient of friction between the screw and the nut is 0.13. Determine the torque required on the screw to raise a load of 25 kN, assuming the load to rotate with the screw. Determine the ratio of the torque required to raise the load to the torque required to lower the load. (11)

(P.T.O.)

71°
 $71^\circ = (R + 6R) \sin \frac{\theta}{2}$

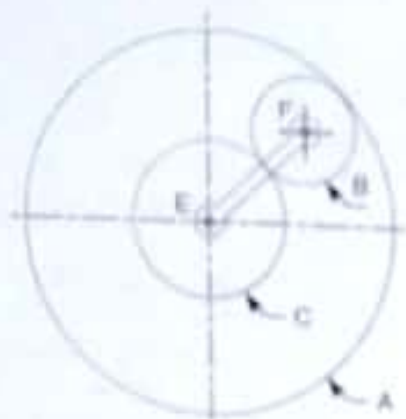
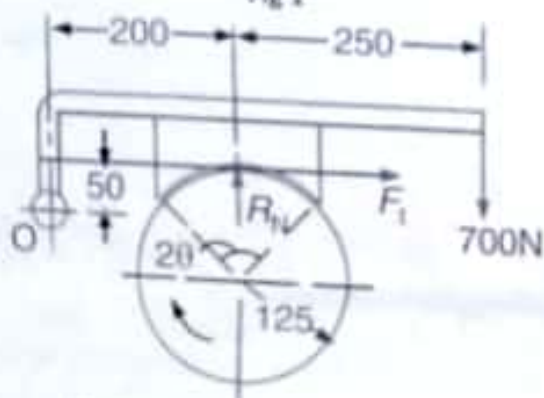
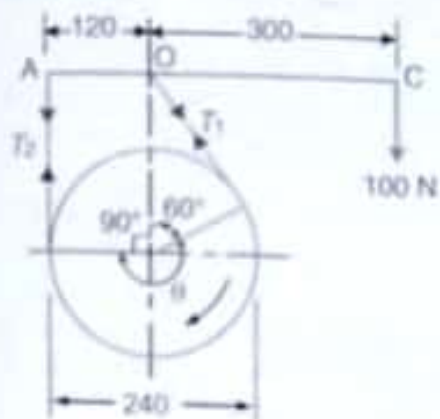


Fig 1



All dimensions in mm.

Fig 3



All dimensions in mm.

Fig 2

$\frac{P \times L}{P} = T_1 \times \frac{L}{P}$

$$\frac{P \times L}{(R + 6R) \sin \frac{\theta}{2}} = \frac{P \times L}{P \sin \frac{\theta}{2}}$$

$$R \times \frac{d\theta}{2} + T \times \frac{dP}{2} \cdot (L + 4R) = 4RN$$

$$R \times d\theta + T \times \frac{dP}{2} \cdot dR = 4RN$$